MECHANICAL ENGINEERING

March 1959

Trip-Free Mechanisms, 48

Writing Papers for Readability, 46

A New Look at Specialized Refractories, 58

A Century of Fear and Hope at the Crossroads, 44

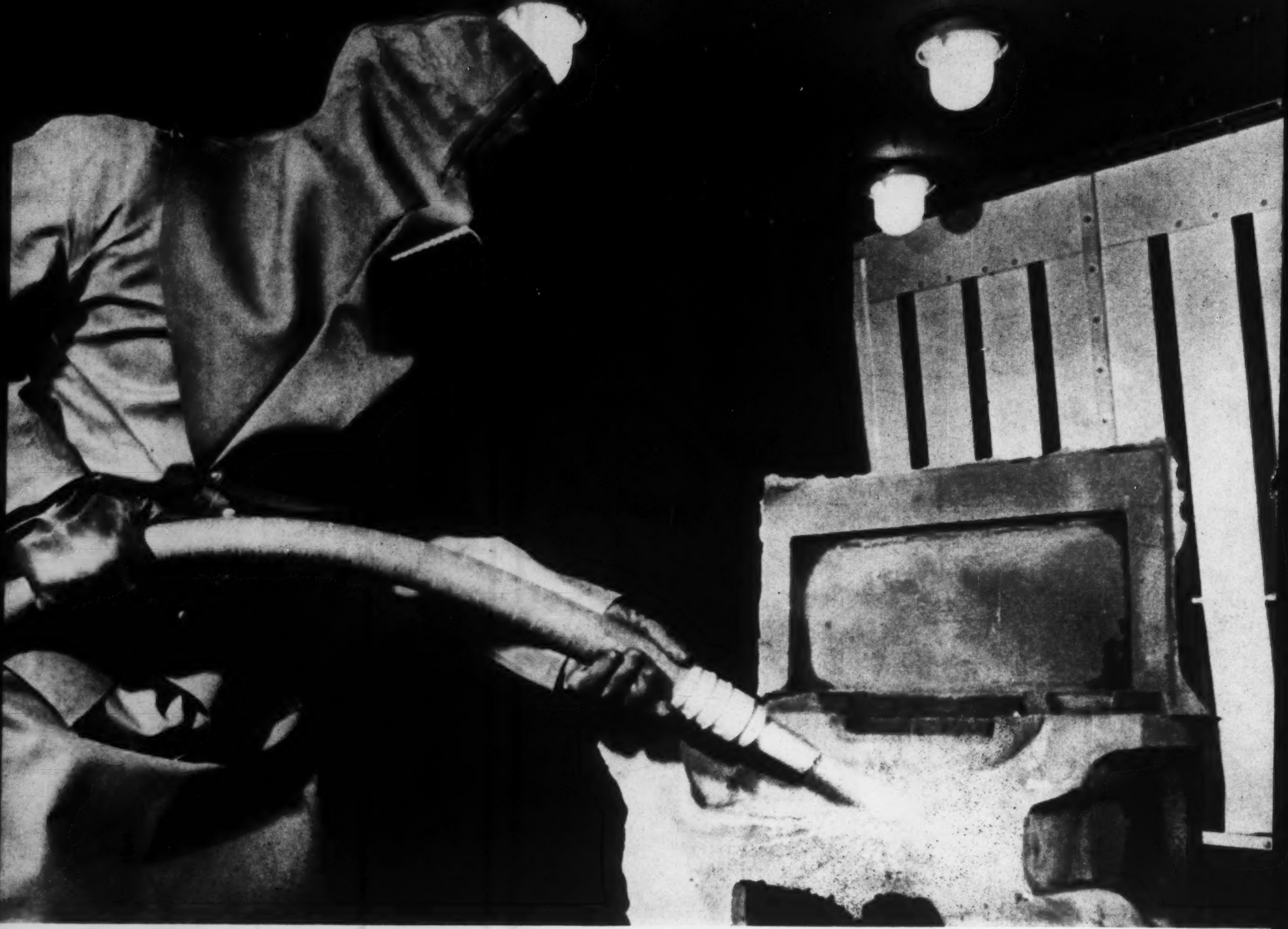
The Professional Divisions of the ASME, 66

Plastics Engineering 1957-1958—

A Review of Developments, 54

Fuel Cells, 63

Steel Outside-Bonded Glass Inside



Steam Supply by B&W

CUTS GREENLEE'S FUEL BILL BY 14%

Rockford Plant Saves Money Despite Coal Costs Rise

In its Rockford, Ill., plant, Greenlee Bros. & Company, one of America's largest machine tool manufacturers, needs a lot of steam. Heating, processing, testing and other functions make big demands on boilers — fired with coal that's gone *up* in price.

Greenlee keeps overhead down by keeping steam generating costs to a minimum — with two dependable, economical B&W Integral-Furnace Boilers. Equipped with B&W Jet Ignition Stokers, these modern units started saving money from the day they were installed.

How do you use steam? Whether you use it for processing, for heating or for power, steam costs play a big part in your production budget. A look at your books will show you you're burning a lot of money—every year. And that's the cost that counts—not the initial cost of the boiler.

Most boilers consume their first cost every year, in fuel. For many boilers, the fuel bill will add up to several million dollars during their normal life expectancy. Efficiency can drop 2 or 3 per cent, or even more, and when this happens, a substantial sum of money literally "goes up the stack." Sound engineering, proper maintenance and servicing can prevent this — turning potential losses into actual savings.

That's why you save on steam costs with a B&W boiler. Long-range sustained economy is the natural result of B&W's top-level engineering and consistent high performance. A national network of plants and engineers — supported by more than a century of steam generating experience — is at your service. Talk over your steam needs with B&W, anytime.

The Babcock & Wilcox Company,
Boiler Division, 161 East 42nd Street,
New York 17, N. Y.

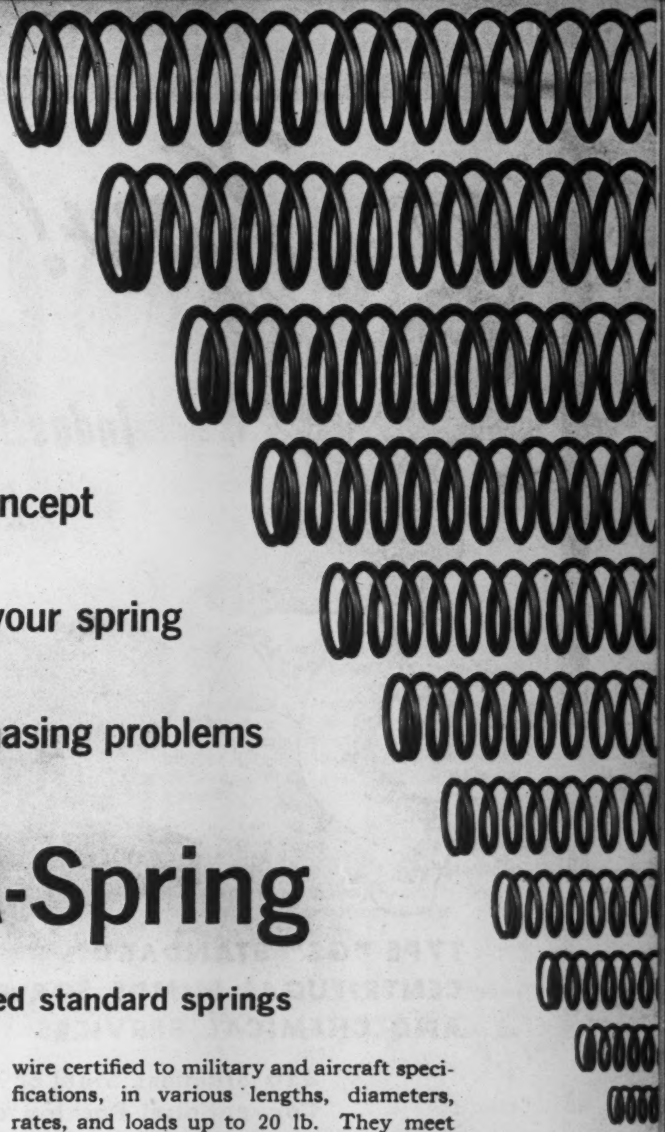
G-836-1B

BABCOCK & WILCOX

B&W

BOILER DIVISION

MODERN STEAM MAKES YOUR PRODUCT BETTER AT LOWER COST



A

new concept

to simplify your spring

design and purchasing problems

Select-A-Spring

ready-to-use engineered standard springs

Now you can select compression or extension springs from hundreds of ready-to-use, engineered standard-specification sizes. No fuss or paper work—no blueprints or drawings necessary. Select-A-Spring enables buyer or designer to pinpoint his needs without delay. Simply match your requirements to the Select-A-Spring list, order by catalog number, quantity and material. Especially convenient where quantities are moderate.

Select-A-Springs are pre-engineered, using wire certified to military and aircraft specifications, in various lengths, diameters, rates, and loads up to 20 lb. They meet industry and military standards. Material is either music wire or stainless steel. Compression springs are squared and ground. Extension springs have regular loops. Other ends and loops optional.

Whether your need is immediate or future, write now for the A.S.C. Select-A-Spring list. Keep it handy as a time-saving, useful spring service.

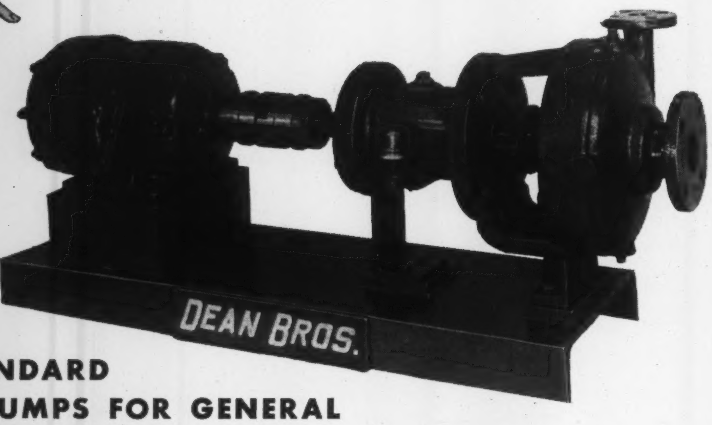
Associated Spring Corporation **General Offices: Bristol, Connecticut**

Wallace Barnes Division, Bristol, Conn. and Syracuse, N. Y.
B-G-R Division, Plymouth and Ann Arbor, Mich.
Gibson Division, Chicago 14, Ill.
Milwaukee Division, Milwaukee, Wis.
Raymond Manufacturing Division, Corry, Penna.
Ohio Division, Dayton, Ohio
F. N. Manross and Sons Division, Bristol, Conn.
San Francisco Sales Office, Saratoga, Calif.
Seaboard Pacific Division, Gardena, Calif.
Cleveland Sales Office, Cleveland, Ohio
Dunbar Brothers Division, Bristol, Conn.
Wallace Barnes Steel Division, Bristol, Conn.
Canadian Subsidiary: Wallace Barnes Co., Ltd., Hamilton, Ont. and Montreal, Que. Puerto Rican Subsidiary: Associated Spring of Puerto Rico, Inc., Carolina, P.R.

5907

Now! **IMMEDIATE SHIPMENT!**

Industry's Most Versatile Line of Pumps



TYPE "GS" STANDARD CENTRIFUGAL PUMPS FOR GENERAL AND CHEMICAL SERVICES

316 Stainless Steel or Cast Iron Construction
Conventional Packing or Mechanical Seal
7 Sizes—up to 600 gal. per min. • Total Dynamic Head—up to 275 ft.
Temperature of Liquid—from minus 40°F to plus 350°F.
Working Pressures—from 28 inches vacuum to 230 lbs. per sq. in., gage.

AVAILABILITY! Orders received before 11 a.m., E.S.T., shipped same day. Complete pumps, sub-assemblies and parts always available.

RELIABILITY! Wide versatility of application and full interchangeability of pumps and parts combine to make Dean Brothers Type "GS" pumps the universal plant standard.

SIMPLICITY! Simple to purchase • Simple to install • Simple to maintain.

See your nearby Dean Brothers Representative listed in
the Yellow Pages of your Phone Book or wire direct.

DEAN BROTHERS PUMPS INC.
Est. 1869
323 West 10th Street, Indianapolis, Indiana

EXPORT OFFICE: 50 CHURCH ST., NEW YORK 7, N. Y. • CABLE ADDRESS—BROSITES

MECHANICAL
ENGINEERING

PUBLISHED BY
THE AMERICAN SOCIETY OF
MECHANICAL ENGINEERS

Contents

VOLUME 81 • NUMBER 3 • MARCH, 1959

EDITORIAL DEPARTMENT

Editor, J. J. JAKLITSCH, JR.
Editor Emeritus, GEORGE A. STETSON
News Editor, E. SYDNEY NEWMAN
Assistant Editor, M. BARRANGON
Assistant Editor, [illegible]
Staff Editor, [illegible]
Art Editor, H. BALFOUR
European Corresp., J. FOSTER PETREE
Production, HILDA F. [illegible]

OFFICERS OF THE ASME

President, [illegible]
Secretary, O. B. SCHIER, II
Treasurer, E. J. KATES
Assistant Treasurer, [illegible]

PUBLICATIONS COMMITTEE

Chairman, JOHN de S. COUTINHO
[illegible]
[illegible]
[illegible]
[illegible]

[illegible]
[illegible]
[illegible]

REGIONAL ADVISORY BOARD

Region I, ROY L. PARSELL
Region II, GLENN R. FRYLING
Region III, F. J. HEINZE
Region IV, FRANCIS C. SMITH
Region V, H. M. CATHER
Region VI, C. R. EARLE
Region VII, [illegible]
Region VIII, [illegible]

THE COVER

Glass bonded to steel. This chemical tank, built by the Pfaudler Company, a division of Pfaudler Permutit Inc., of Rochester, N. Y., is believed to be the world's largest glassed-steel reactor with agitator. A glass emulsion is sprayed on the inside of the tank and fired to bond it to the steel. Six coats. Result: A smooth glass interior, impervious to all acids except hydrofluoric. This 7150-gal reactor will handle monochloroacetic acid and alcohol, at 158 F, and uses a 3-bladed glassed impeller with glassed shaft.

A CENTURY OF FEAR AND HOPE AT THE CROSSROADS................................**E. N. Schieldrop** **44**

We have become so dangerous to ourselves that we face an ultimate choice...co-operative effort, or a final, all-destroying conflict. For a brief while yet, science has its greatest opportunity.

WRITING PAPERS FOR READABILITY.......................**J. S. Fielden** **46**

You can write by "formula" for a computer. If you're writing for people you need skill, patience, and thought—especially thought. Here are suggestions for composing the technical article.

TRIP-FREE MECHANISMS......................................**H. L. Peek** **48**

The circuit breaker is closed: The closing prime mover is holding it closed, though the circuit has faulted. But the breaker trips free. Here's a report on mechanisms devised for this service.

PLASTICS ENGINEERING 1957–1958—A REVIEW OF DEVELOPMENTS....................**R. I. Leininger and R. A. Clark** **54**

The multibillion-dollar story of plastics—from thermoplastic pipe to tools and dies, from boats to missiles. Did you know that the construction industry takes 15 per cent of the huge total?

A NEW LOOK AT SPECIALIZED REFRACTORIES............**R. W. Brown** **58**

Look beyond the name. "Refractories" may have other properties—hot strength; resistance to wear, corrosion, and thermal shock; a range of thermal conductivities. From Carborundum, this report.

FUEL CELLS...............................**Everett Gorin and H. L. Recht** **63**

This is thermoelectricity, Seebeck's century-old discovery, the direct transformation of heat into electricity. Now science is working swiftly to perfect this generator of electrical energy.

THE PROFESSIONAL DIVISIONS OF THE ASME......................... **66**

One day, you'll present a technical paper at a meeting of ASME, a paper first reviewed and recommended by one of the Divisions. Get acquainted with the Divisions in whose fields you operate.

Contents continued on following page

How B&W JOB-MATCHED TUBES meet Heat-Exchanger requirements

With B&W Job-Matched Heat-Exchanger Tubes you get:

- . . . tube tolerances and mechanical properties, controlled for ease of fabrication
- . . . a wide range of steels to meet any set of operating conditions
- . . . a complete range of tube sizes, for any type of heat exchanger

This means ease of fabrication to the heat-exchanger manufacturer — long service life to the heat-exchanger user—and ease of tube replacement to those concerned with maintenance.

For complete information about B&W Job-Matched Heat-Exchanger Tubes call the local B&W District Sales Office or write for Bulletin TB-329. The Babcock & Wilcox Company, Tubular Products Division, Beaver Falls, Pennsylvania.

B&W

THE BABCOCK & WILCOX COMPANY

TUBULAR PRODUCTS DIVISION

TA-9002-SPI

Seamless and welded tubular products, solid extrusions, seamless welding fittings and forged steel flanges—in carbon, alloy and stainless steels and special metals

MECHANICAL
ENGINEERING

PUBLISHED BY
THE AMERICAN SOCIETY OF
MECHANICAL ENGINEERS

Contents (continued)

VOLUME 81 • NUMBER 3 • MARCH, 1959

Departments

EDITORIAL 43

BRIEFING THE RECORD 77
Bus Trains 77
Heat-Exchanger Tube-Bundle Extractor 78
Human-Factors Instrumentation 79
Split Ball Bearing Plant 79
Mechanical Fuel-Cladding Removal 80
Nuclear Auxiliary Power 80
Nuclear Briefs 80
81 Materials Briefs
82 Electronic Flight Visulator
83 Diesel Power Engines
83 Gear Checker
84 Magnetic Filter Bed
84 100-Ton Stamping Press
84 Hydro Progress in Canada
85 Diesel-Engine Test Facility
85 River Rouge Sets Record

PHOTO BRIEFS 86
Coast to Coast in 1 Hour 86
Automatic Stacker 86
Seven Cams Checked Simultaneously 86
Heating, Cooling, and Light—in One Panel 87
Aluminum Network-Transformer Tank 87
Turbine-Blade Design Speeded 87
Hydraulic Turbines for Fort Peck Dam 87
87 Overhead Aluminum Crane
88 Ducts for Wide Temperature Range
88 Vertical-Lift Aircraft
88 Creep-Strain Test Monitor
89 Powder-Metallurgy Use in Autos
89 Chatterless Height Check
89 Center Scriber
89 Iron-Ore Facility
89 Missile-Component Tester

EUROPEAN SURVEY 90
British Uranium Fuel-Element Plant 90
92 Excavator for Brown Coal
92 Stokers for British Railways

ASME TECHNICAL DIGEST 93
Lubrication 93
Management 97
Applied Mechanics 98
Furnace Performance Factors 99
Mechanical Pressure Elements 100
Rubber and Plastics 101
Power 101
102 Fluid Mechanics
102 Heat Transfer
107 Instruments and Regulators
107 ASME Transactions (Journal of Engineering for Industry and Journal of Heat Transfer) for February, 1959

COMMENTS ON PAPERS 108

REVIEWS OF BOOKS 108

BOOKS RECEIVED IN LIBRARY 109

THE ROUNDUP 111
Solid Nuclear Fuel Elements 111
American Power Conference Program 112
Fluid and Solid Mechanics Midwest Conference 115
114 People
115 Education
117 Meetings of Other Societies
117 Literature
119 United Engineering Center

THE ASME NEWS 120
Technology Executives Conference 120
Textile Engineering Conference 123
Stall and Fluid Flow Symposium 123
Oil and Gas Power Conference 124
Metals Engineering Conference 125
Production Engineering Conference 126
1959 RAC Meetings Schedule 126
ASME Coming Events 127
Design Engineering Conference 127
1959 Student Conferences 128
128 ASME Codes and Standards Workshop
131 Junior Forum
132 ASME Executive Committee
133 Nominations Wanted
133 ASME Group Insurance Program
134 Personnel Service
137 Candidates
138 Obituaries

KEEP INFORMED 141

CLASSIFIED ADS 191

202 .... CONSULTANTS

204 .... ADVERTISING INDEX

ADVERTISING DEPARTMENT

Publications Business Manager,
S. A. TUCKER

Advertising Manager,
C. R. TUNISON

Promotion Manager,
W. S. LANGER

Sales Representatives,
WILLIAM LAURIE
29 West 39th Street,
New York 18, N. Y.
HARRY LEHNHARDT
84 East Randolph St.,
Chicago 1, Ill.
WILLIAM BALDWIN
2828 South Moreland Blvd.,
Cleveland 20, Ohio
DILLENBECK-GALAVAN INC.
266 South Alexandria Avenue,
Los Angeles, Calif.
FRED W. SMITH & ASSOCIATES
1201 Forest View Lane, Vesthaven,
Birmingham 9, Ala.

Business Manager,
M. H. MARTY

Published monthly by The American Society of Mechanical Engineers. Publication office at 20th and Northampton Streets, Easton, Pa. Editorial and Advertising departments at the headquarters of the Society, 29 West Thirty-Ninth Street, New York 18, N. Y. Cable address, "Mechaneer," New York. Price to members annually $3.50 for initial membership subscription, $5.60 for additional subscriptions, single copy 50 cents; to nonmembers annually $7.00, single copy 75 cents. Add $1.50 for postage to all countries outside the United States, Canada, and the Pan American Union. Changes of address must be received at Society headquarters seven weeks before they are to be effective on the mailing list. Please send old as well as new address ... By-Laws: The Society shall not be responsible for statements or opinions advanced in papers or ... printed in its publications (B13, Par. 4) ... Second-class mail privileges authorized at Easton, Penna. ... Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized on January 17, 1921 ...

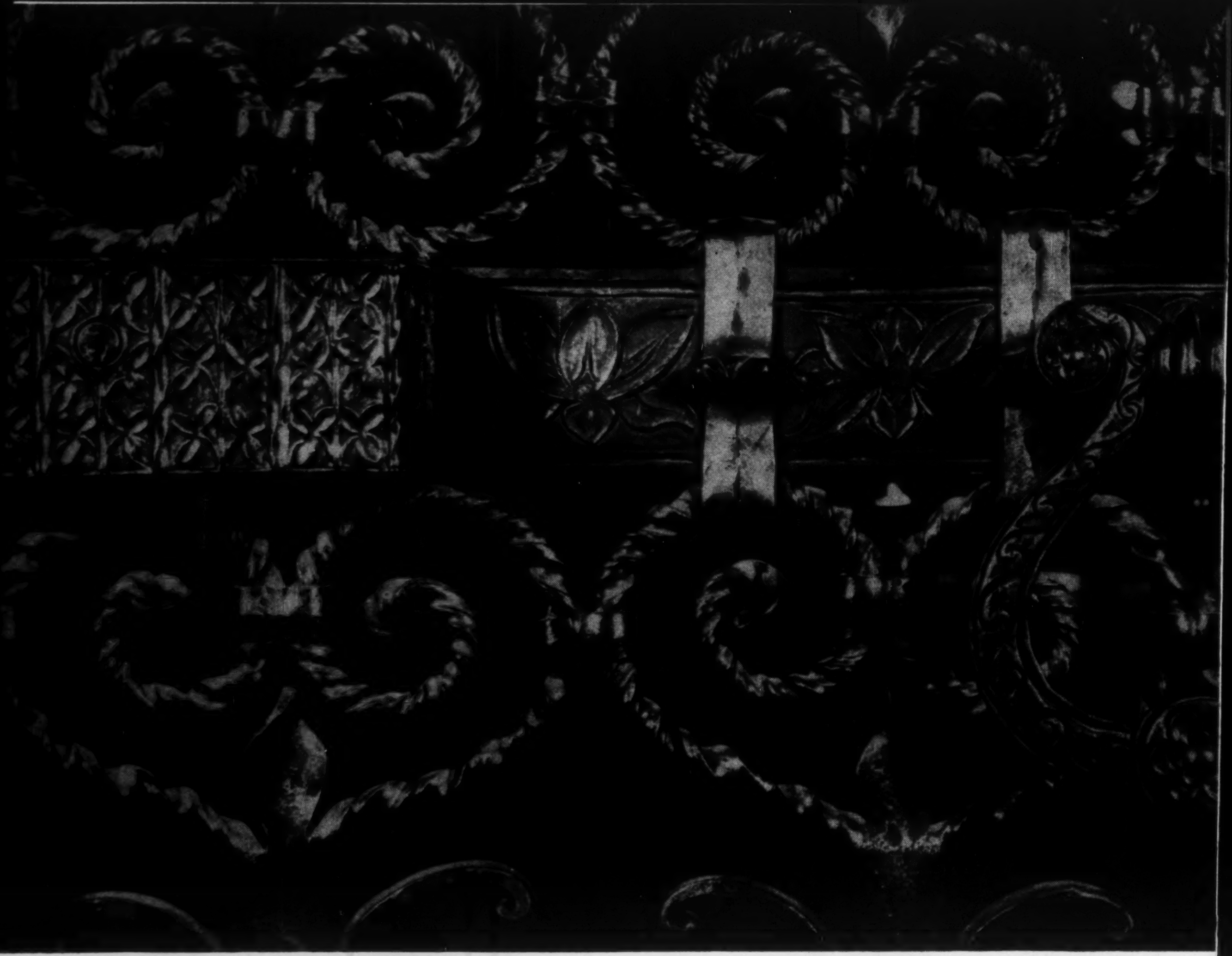
©Copyrighted, 1959, by The American Society of Mechanical Engineers.

Member of the Audit Bureau of Circulation. Reprints from this publication may be made on condition that full credit be given MECHANICAL ENGINEERING and the author and that date of publication be stated.

57,000 copies of this issue printed

MECHANICAL ENGINEERING
is indexed by the Engineering Index, Inc.

READERSHIP
RESEARCH



Formability—In days of old, when knights were bold, they also were smart. When their very lives depended on a tool or a weapon, they made sure it was made from steel. It could be a great claymore, hefty enough to behead a horse; a bright suit of armor that would turn the Saracen's arrow; or an ornamental castle gate, strongly made to frustrate the assassin.

They wanted steel because it was strong. They could *use* it because it was formable. Truly, there is no economical metal in all the world that can approach steel's combination of strength and formability.

With the near-magic of heat treating, you can soften steel and form it, then harden it to make it strong, then temper it to make it tough. Or form it cold. Use bending, flanging, deep drawing, spinning, cold heading, die drawing, rolling, wiper forming, draw rolling, stretch forming or bumping. In fact, it's hard to imagine any forming operation that cannot be performed on steel.

Fortunately, there are hundreds of different kinds of steel; and they all act differently in the fabricating shop. Everything you do to steel alters its *forming* properties, and every forming operation alters its physical properties.

The aim of the product designer is to find a steel that can be properly formed, that has the right strength, toughness, corrosion resistance, weldability or other characteristics required . . . at the most favorable cost. If you have a design problem and the comptroller is looking over your shoulder, take hope from this idea: there is one "best" steel for any design application. You can be sure of finding it among the great family of USS Design Steels: Carbon, High Strength, Alloy and Stainless Steels.

If you need help in making your selection, ask a company that has produced well over a billion tons of steel, and has spent hundreds of millions of dollars to learn more about this most versatile of man's metals. Of course that means United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

United States Steel Corporation • American Steel & Wire • Columbia-Geneva Steel • National Tube
Tennessee Coal & Iron • United States Steel Supply • United States Steel Export Company

USS **United States Steel**

Lower Left—Problem: Build a power shovel dipper stick with greater strength and shock resistance. Solution: Bucyrus-Erie Company designed a tubular stick made from USS "T-1" Constructional Alloy Steel. Payoff: The "T-1" Steel plates were easily cold-formed into a tube and butt welded. The tubular design and stronger steel assured great strength and shock resistance, and easy fabrication.

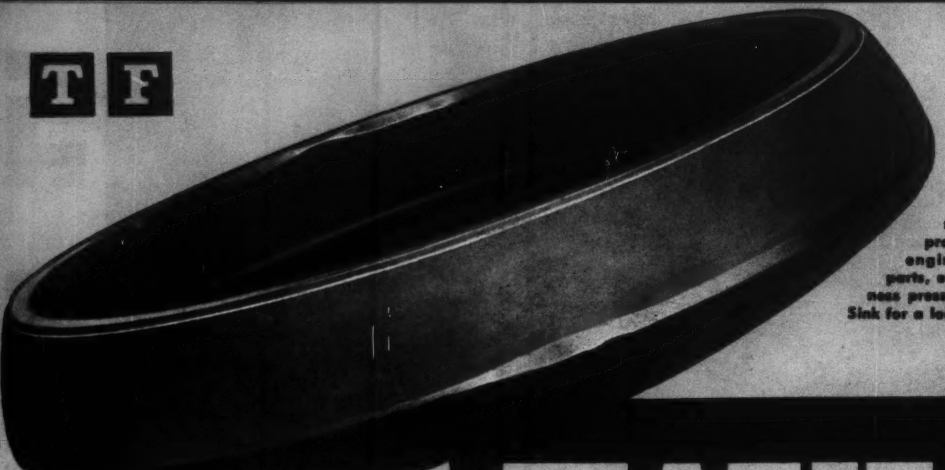
Lower Middle—Problem: Produce strong, heat resistant, corrosion resistant jet engine rings—*economically*. Solution: Alloy Manufacturing Company carefully selected a grade of USS Stainless Steel. Payoff: The rings resist heat and corrosion and they are economically roll-formed because the Stainless Steel is formed on "carbon steel rated" equipment.

Lower Right—Problem: Design a pressure tank that is just as strong but lighter than conventional carbon steel tanks. Solution: Manufacturer selected USS MAN-TEN High Strength Steel. Payoff: MAN-TEN's greater strength (50% higher yield point than carbon steel) permitted design of a thinner-walled tank that is 24% lighter. And because MAN-TEN is highly formable, the tank is economically produced by cold press forming of circular blanks into seamless shells, 29" in diameter and 24" deep.

USS, "T-1" and Man-Ten are registered trademarks

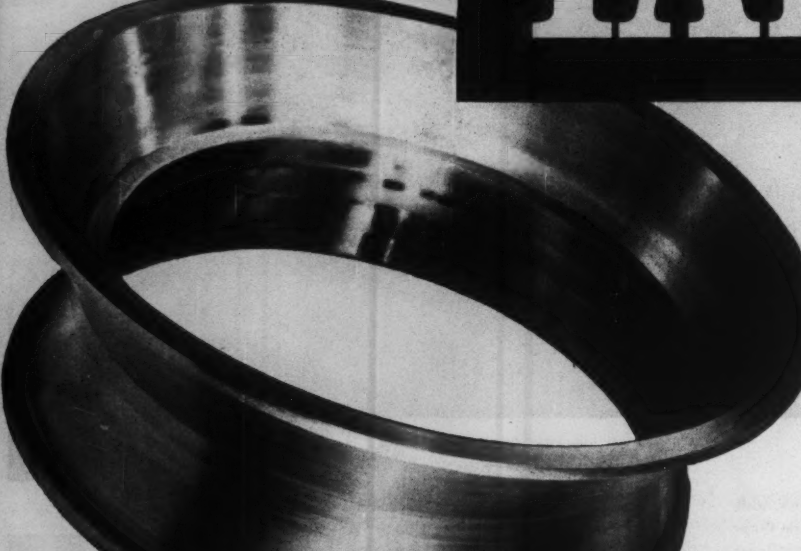
STEELS FOR DESIGN

T F



Precision Press Forgings (as well as Hammer Forgings and Extrusions) are made in quantity on a production basis as missile, rocket and engine components, heavy machinery parts, etc. This 64⅜" OD x 1½" wall thickness press-forged stainless steel part is a Heat Sink for a long range missile.

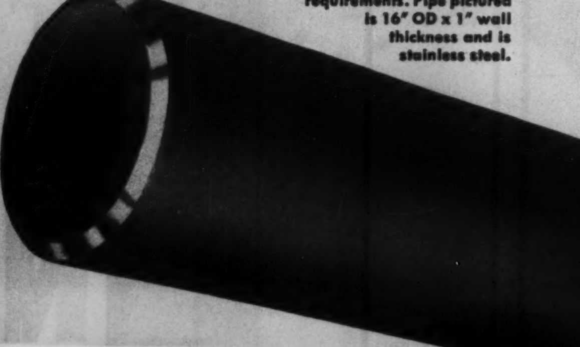
TAYLOR



This 42" OD x 16" long Stainless Steel Jet Engine Turbine Case is representative of products formed by Taylor Forge ring rolling methods. Seamless rings are made in sizes to 120" OD with practically any required section.

Forged Headers with contoured outlets, made with any required outlet arrangement, are widely used for valve settings, gas compressor station manifolds, scraper traps, refinery charge heater headers, and many other applications in gas, oil and process piping. They are also made in heavy wall thicknesses for high pressure-temperature central power station service.

Electric Fusion Welded Pipe is made in sizes from 14" OD to 96" OD with wall thicknesses to 1.531", and in a variety of materials (including stainless and alloy steels). This pipe offers many opportunities for substantial economies, particularly in high pressure-temperature services and also in pipeline river crossings and other applications involving special design requirements. Pipe pictured is 16" OD x 1" wall thickness and is stainless steel.



SERVING INDUSTRY with many essential products

FORGE

Traditionally Dependable

Perhaps you think of Taylor Forge only as a maker of highest quality Welding Fittings and Forged Flanges—and certainly they are most important lines with us. But Taylor Forge is also an outstanding producer of many other less widely known though equally essential products.

The few examples pictured here are representative of the many diverse parts made by Taylor Forge to serve American Industry. One thing they have in common is the dependability, the integrity, that has always been associated with the name TAYLOR FORGE.

TAYLOR FORGE

Taylor Forge & Pipe Works

General Offices and Works: P. O. Box 485, Chicago 90, Illinois
Plants at: Carnegie, Pa., Gary, Ind., Houston, Texas, Fontana, Calif., Hamilton, Ont., Canada
District Sales Offices: New York, Boston, Philadelphia, Pittsburgh, Atlanta, Chicago,
Houston, Tulsa, Los Angeles, San Francisco, Seattle, Toronto, Calgary, Montreal.

Taylor Forge was America's first and is still the foremost manufacturer of Welding Necks, Nozzles, Large Diameter Flanges and similar boiler, heat exchanger and other pressure vessel components. Such parts are made in any size and material for any service condition.

TF TAYLOR FORGE 12¾ X 1793 TESTED TO 789 LBS. 4211

Spiral-Weld Pipe, our original product, (first made as spiral riveted pipe nearly 60 years ago), remains to this day a major item and its use continues to expand. Its money saving features are widely recognized in services such as gas gathering lines; gas, oil and water well casing; irrigation pipe; water piping in sand, gravel and mining operations; and in fact, wherever the use of light weight pipe is indicated. It is also widely used as pipe piling.

rigid specifications

Tension tests are required to be made at room temperatures and at 670° F. The following minimum physical properties shall be met:

At Room Temperature:

TS	YS	EL	RA	CHARPY V-NOTCH
70,000	30,000	45	50	50

At 670° F. the minimum tensile strength shall be 51,000 p.s.i. and the minimum yield strength 18,300 p.s.i.

Rejection

Each casting that develops unacceptable defects during shop working or fails to conform to all of the requirements of these specifications shall be rejected. No repair by welding or other means will be permitted.

Radiographic Inspection

(a) Paragraph S5 (a) of the Supplementary requirements of ASTM-A 362-52T.

(b) All castings shall be radiographed 100% and shall conform to ASTM-E7 1-52, Class 2 quality, except as modified by these specifications.

(c) The manufacturer shall establish a positive system of identification of the X-ray plates which shall be subject to approval by the inspector. This system shall guarantee complete coverage by radiographing and provide for positive identification between the plate and the subject.

Inspection of Penetrants

All castings shall be subjected to inspection by fluorescent penetrants or penetrating dyes both inside and out. All cracks, porosity, or flaws revealed as a result of the Dye Penetrant Test shall be due cause for rejection of the casting.

All cast pipe shall be hydrostatically tested to 5,900 p.s.i. and held at that pressure for 20 minutes with zero pipe leakage. Each length of pipe shall be hydrostatically tested at the manufacturer's plant.

The 304L stainless steel shall conform to the following ladle analysis:

Carbon	.03 max.		
Manganese	1.50% max.		
Phosphorous	.03% max.		
Sulphur	.03% max.		
Silicon	2.00% max.		
Chromium	18.00	-	21.00%
Nickel	8.00	-	11.00%

Pipe: All pipe of the following sizes shall be centrifugally cast stainless steel as per ASTM-A 362-52T, except as modified by these specifications:

16" - Sch. #160
12" - Sch. #160
10" - Sch. #160
8" - Sch. #140

All pipe shall be machine finished to 125 micro-inch interior and exterior.

for nuclear piping met by U. S. PIPE metal mold process

Centrifugally Cast Stainless Steel Solves Many Piping Problems

Combinations of temperatures, pressures and corrosive conditions never encountered before: these are among the piping problems that must be overcome by the men who design the nation's nuclear power installations.

Stainless steel centrifugally cast pipe provides many of the answers. Study the specifications at the left . . . specifications demanded of stainless steel pipe on a recent job for Paul Hardeman, Inc., Los Angeles, California. This pipe is being used for heavy duty, high pressure, elevated temperature service in the primary piping system of the SPERT-III Reactor at the U. S. Atomic Energy Commission's National Reactor Testing Station near Idaho Falls, Idaho. The Stearns-Roger Mfg. Company, Denver, Colorado, is the architect-engineer on this project. A complete tabulation of the actual test data obtained on this pipe and to this specification is available upon request.

U. S. Pipe is headquarters for metal mold centrifugally cast alloy and stainless steel pressure pipe over a wide range of special and standard analyses—in large and small quantities—and to individual specifications.

If piping of the type described above is the bottleneck in your nuclear power planning, write and outline the problem.

SIZE RANGE AND COMPOSITION FLEXIBILITY

Outside Diameter—6" to 50"

Wall Thickness—⅜" and up

Length—Up to 16'

Types of Stainless—All Standard AISI and ACI grades of ferritic and austenitic stainless, including No. 20 Alloy, 17-4 P H, 17-7 P H and E. L. C. grades.

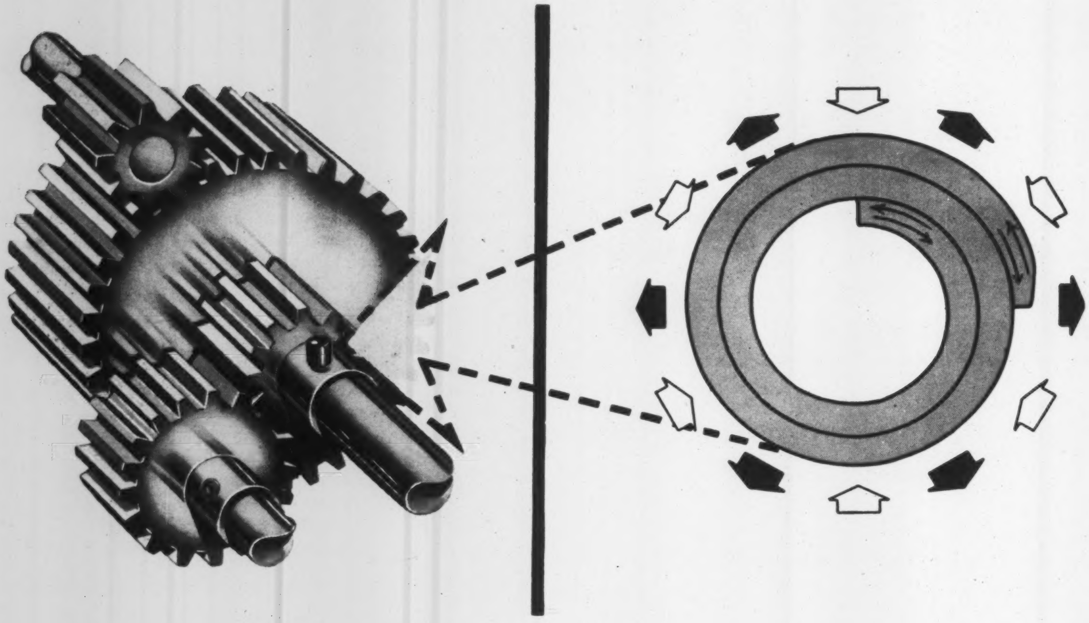
UNITED STATES PIPE & FOUNDRY CO.

Steel and Tubes Division

STEEL & TUBES U.S. PIPE DIVISION

BURLINGTON, NEW JERSEY

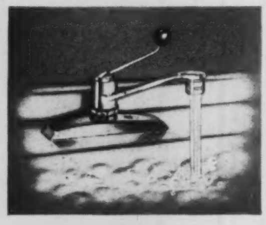
SALES OFFICES: LOS ANGELES, SAN FRANCISCO, CHICAGO, ST. LOUIS, COLUMBUS, PITTSBURGH, [illegible], [illegible]



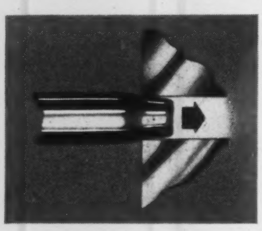
This spring pin's strength . . . comes from true spring *coils*

Full 360° radial spring action gives SPIROL true spring pins the ability
to withstand repeated, heavy shock and vibration. When compressed, the unique
spiral coils distribute stress evenly throughout the cross-section.
There is *no stress concentration* at any point — no critical cross-section
even with non-heat-treated metals. SPIROL's novel design gives
you *all* the *cost-saving* benefits of a true spring pin.

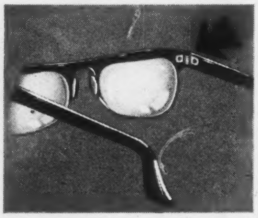
SPIROL gives these unique advantages



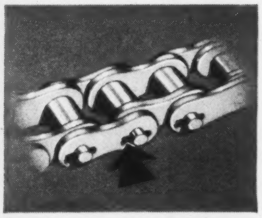
Non-heat-treated metals — such as low-cost brass, copper, nickel stainless steel — can be used in SPIROL true spring pins. Less resilient metals flex without failure, because there is no concentration of stress.



Wider hole tolerances eliminate reaming, reduce drilling rejects, cut production costs. Both plus *and* minus tolerances are allowed because of SPIROL spring pin's greater flexibility in expansion and compression.



Miniature sizes retain flexibility and strength of the spiral cross-section. SPIROL is the only spring-type pin made in miniature diameters: 1/32″ — .039″ — 3/64″ — .052″. Standard diameters up to 1/2″ in stock.



Shock resistance — extremely high resistance to shock, shear, and vibration permits use of "medium duty" SPIROL pins in the majority of applications. Heavy and light duty SPIROL pins are also available in stock.

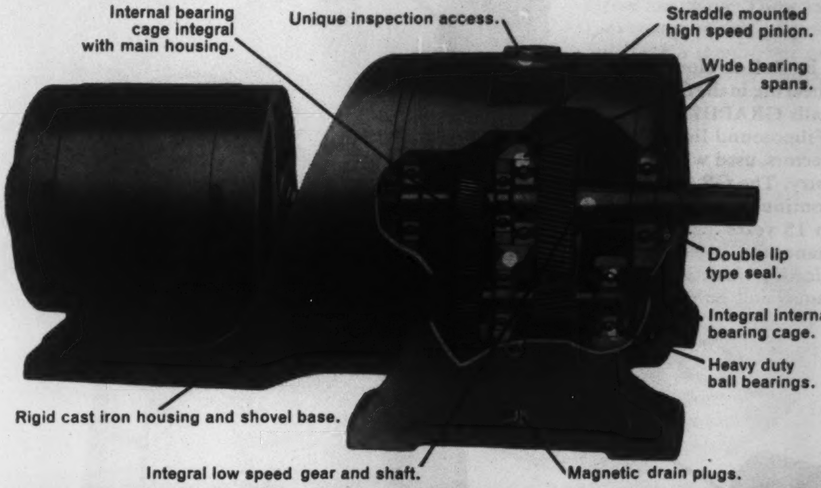
FREE! *Write for complete literature on* SPIROL *spring pins, including price list.*

® **SPIROL** *the true spring* **PIN**

C. E. M. COMPANY • 127 SCHOOL STREET • DANIELSON, CONNECTICUT

Phone: PRescott 4-2411

more user benefits per dollar


Internal bearing cage integral with main housing.
Unique inspection access.
Straddle mounted high speed pinion.
Wide bearing spans.
Double lip type seal.
Integral internal bearing cage.
Heavy duty ball bearings.
Rigid cast iron housing and shovel base.
Integral low speed gear and shaft.
Magnetic drain plugs.

All-motor gearmotor

StraitLine speed reducer

All-motor gearmotor with right-angle head

Integral gearmotor

Vertical gearmotor

with WESTERN GEAR STRAITLINE GEARMOTORS!

For 25 years, Western Gear has designed and manufactured gearmotors for major electric motor manufacturers. During this quarter century, Western Gear has gained matchless experience in the gearmotors field and has learned exactly what gearmotor users want. Feature-for-feature, Western Gear StraitLine Gearmotors, now manufactured and marketed under Western Gear's own name, offer users the greatest list of benefits in the field. If you buy gearmotors, either as a user or an OEM supplier, the full story of the benefits for you in Western Gear StraitLine Gearmotors is required reading and listening. Get the story from your nearby Western Gear man or distributor. And for a starter, use the coupon in this ad to get our basic bulletin No. 5806-F.

WG INDUSTRIAL PRODUCTS DIVISION

PLANTS AT LYNWOOD, PASADENA, BELMONT, CALIF., SEATTLE AND HOUSTON—REPRESENTATIVES IN PRINCIPAL CITIES

WESTERN GEAR CORPORATION
Industrial Products Division
P.O. Box 126 • Belmont, California
Send me Bulletin 5806F

NAME____________________
TITLE____________________
COMPANY____________________
ADDRESS____________________
CITY__________STATE__________

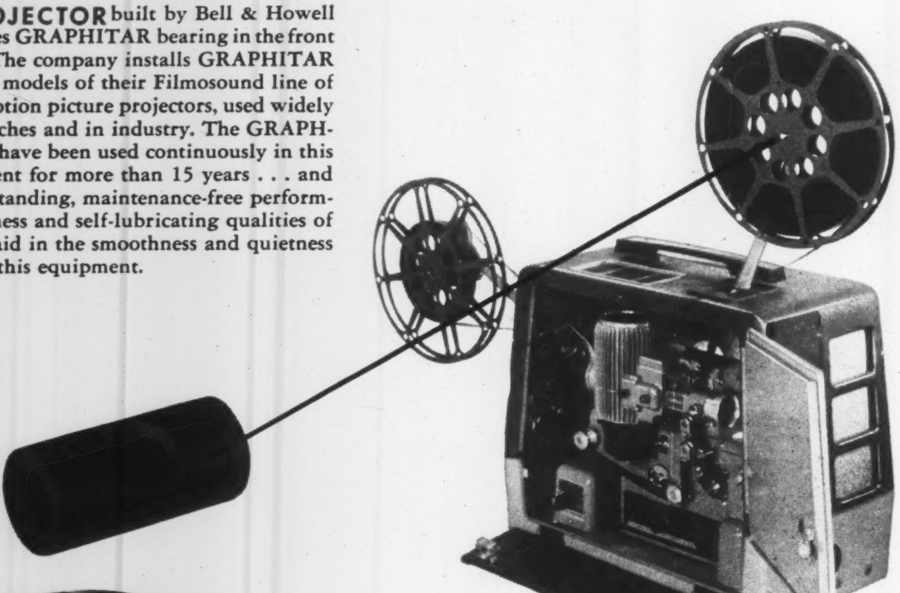
5901

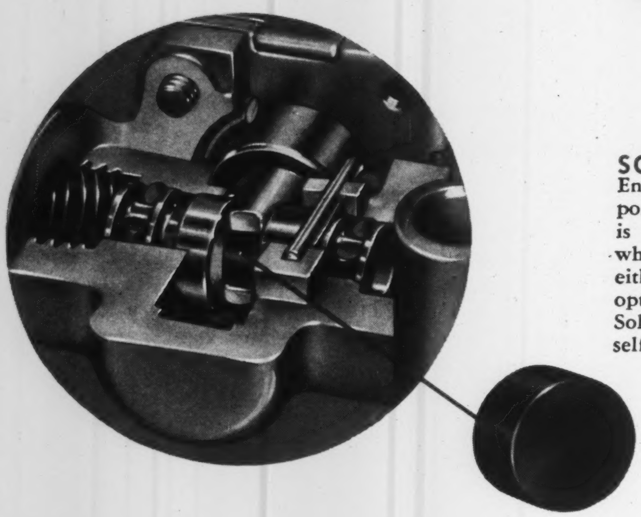
this is GRAPHITAR®

(CARBON-GRAPHITE)

successful in a wide variety of applications

MOVIE PROJECTOR built by Bell & Howell Company utilizes GRAPHITAR bearing in the front reel assembly. The company installs GRAPHITAR bearings in five models of their Filmosound line of 16mm sound motion picture projectors, used widely in schools, churches and in industry. The GRAPHITAR bearings have been used continuously in this line of equipment for more than 15 years . . . and have given outstanding, maintenance-free performance. The hardness and self-lubricating qualities of GRAPHITAR aid in the smoothness and quietness of operation in this equipment.

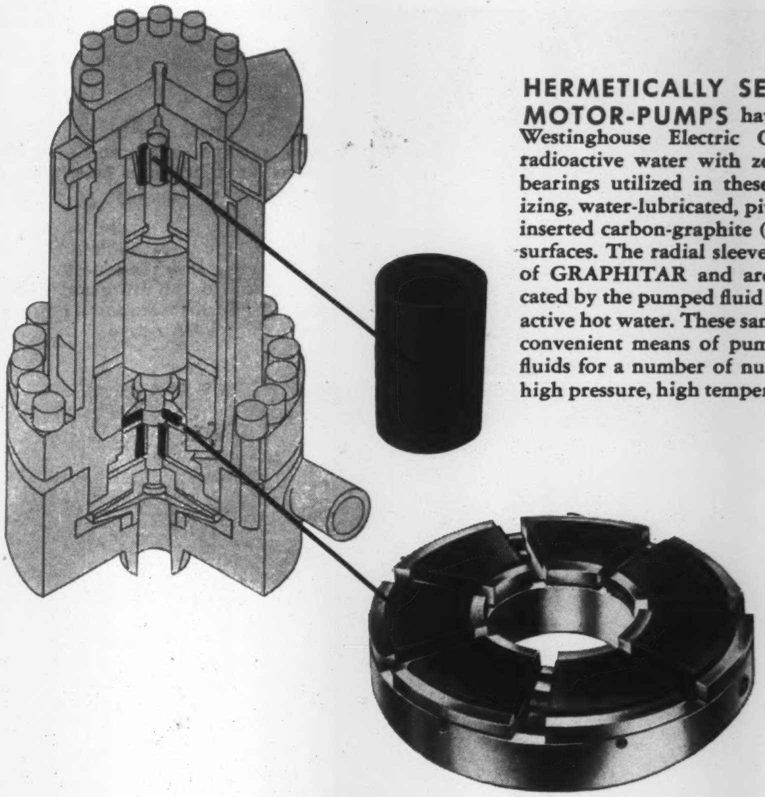




SOLENOID VALVES manufactured by Valcor Engineering Co. for use in guided missiles incorporate a floating seal of GRAPHITAR. This seal is a precise, optically flat GRAPHITAR disc which floats in the plunger. A slight pressure, from either direction, moves the disc against an equally optically flat, stainless steel seat, sealing perfectly. Solenoid valve improves with use due to unique self-lapping action of GRAPHITAR.

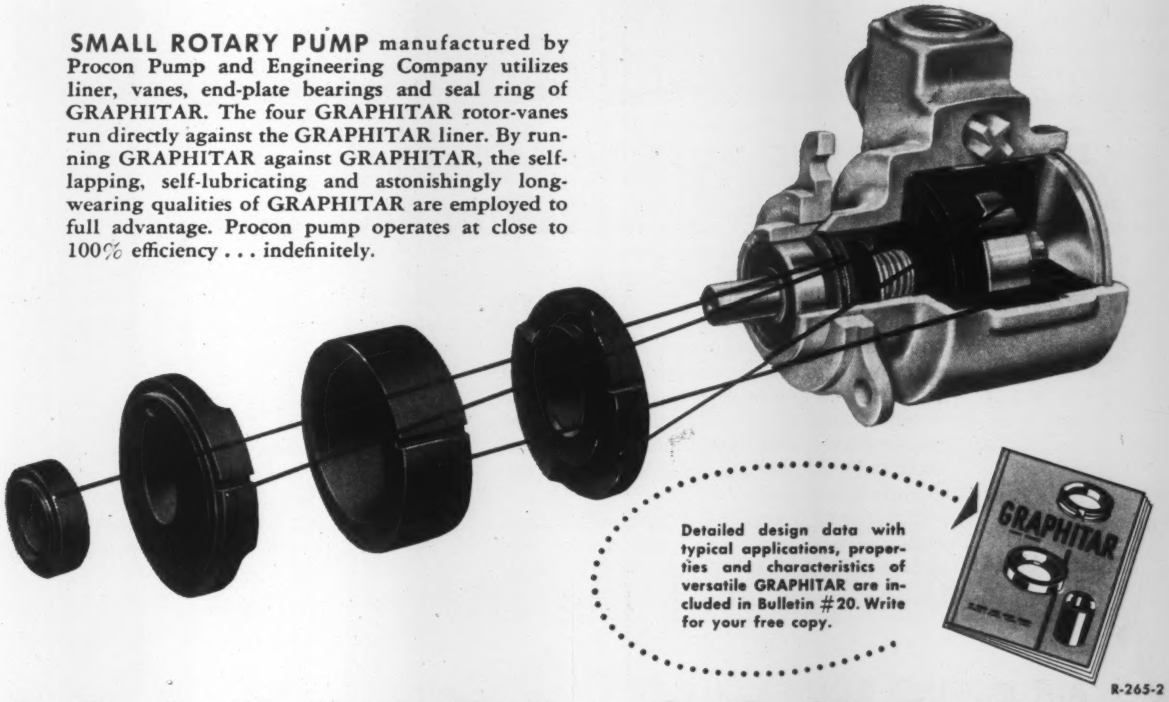
THE UNITED STATES

GRAPHITAR® CARBON-GRAPHITE • **GRAMIX®** POWDER METALLURGY • **MEXICAN®** GRAPHITE PRODUCTS • **USG®** BRUSHES



HERMETICALLY SEALED MOTOR-PUMPS have been developed by Westinghouse Electric Corporation to handle radioactive water with zero leakage. The thrust bearings utilized in these pumps are self-equalizing, water-lubricated, pivoted-pad bearings with inserted carbon-graphite (GRAPHITAR) bearing surfaces. The radial sleeve bearings are also made of GRAPHITAR and are designed to be lubricated by the pumped fluid only, in this case, radioactive hot water. These same pumps have proven a convenient means of pumping high temperature fluids for a number of nuclear reactors and other high pressure, high temperature fluid applications.

SMALL ROTARY PUMP manufactured by Procon Pump and Engineering Company utilizes liner, vanes, end-plate bearings and seal ring of GRAPHITAR. The four GRAPHITAR rotor-vanes run directly against the GRAPHITAR liner. By running GRAPHITAR against GRAPHITAR, the self-lapping, self-lubricating and astonishingly long-wearing qualities of GRAPHITAR are employed to full advantage. Procon pump operates at close to 100% efficiency . . . indefinitely.

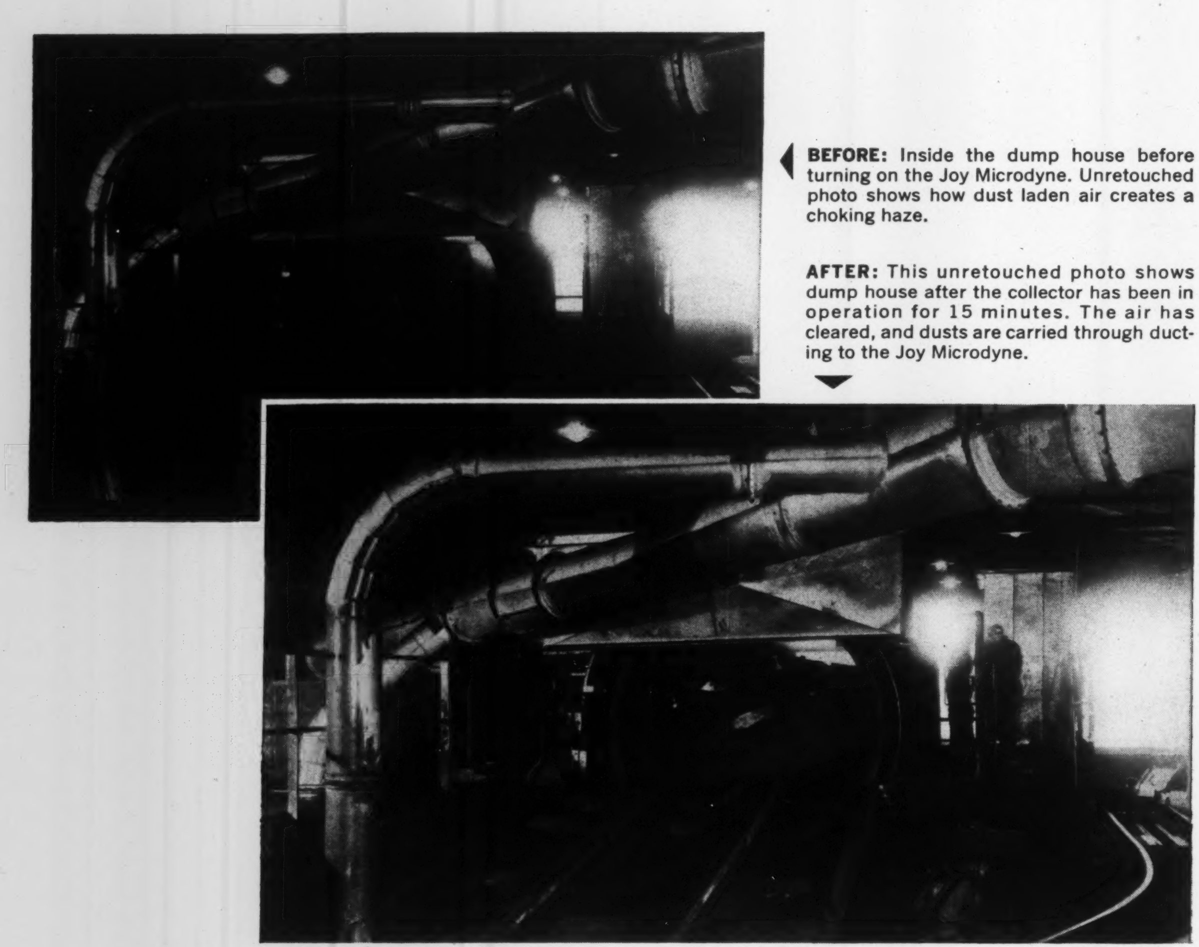


Detailed design data with typical applications, properties and characteristics of versatile GRAPHITAR are included in Bulletin #20. Write for your free copy.

R-265-2

GRAPHITE COMPANY

DIVISION OF THE WICKES CORPORATION, SAGINAW 4, MICHIGAN



BEFORE: Inside the dump house before turning on the Joy Microdyne. Unretouched photo shows how dust laden air creates a choking haze.

AFTER: This unretouched photo shows dump house after the collector has been in operation for 15 minutes. The air has cleared, and dusts are carried through ducting to the Joy Microdyne.

WSW I 7431-284

JOY MICRODYNE DUST COLLECTOR GIVES CLEAN AIR . . . EVEN IN COAL DUMP

A large coal mine had a serious dust problem. Coal dust from a rotary car dump would fill the air in the building in which the equipment was housed. Over a period of two shifts, so much dust would settle that the conveyor equipment under the dump would clog with dust. A maintenance man would spend most of the third shift with shovel and broom to clear the accumulated dust.

After a 32,000 cfm Joy Microdyne dust collector was installed, maintenance was reduced to a general once-a-week cleaning. By mounting the Microdyne halfway between the car dump and a large crusher house, and connecting them with stainless steel tubing, the one dust collector serves both buildings.

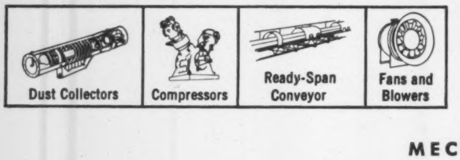
The Joy Microdyne is a new kind of dust collector, 1/10 to 1/20 the size of any other collector. It is extremely efficient and simple to install and is especially suited for conditions encountered in mining and heavy industry.

If *your* operation has a dust problem, why not talk to a Joy engineer.

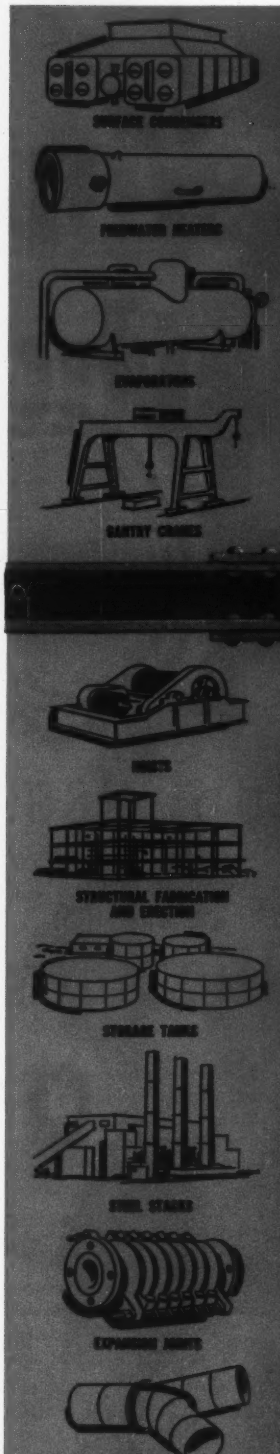
Write for Bulletin 284-80 B

AIR MOVING EQUIPMENT FOR ALL INDUSTRY

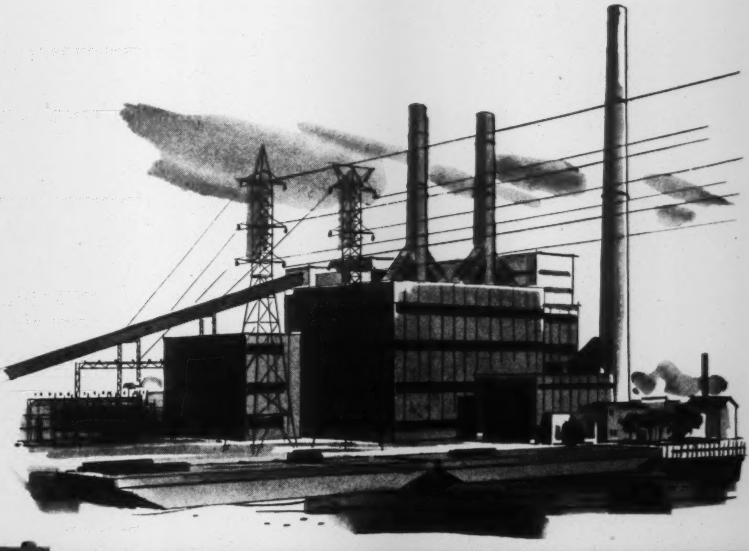
JOY



Joy Manufacturing Company
Oliver Building, Pittsburgh 22, Pa.
In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario


SURFACE CONDENSERS
FEEDWATER HEATERS
EVAPORATORS
GANTRY CRANES
HOISTS
STRUCTURAL FABRICATION AND ERECTION
STORAGE TANKS
STEEL STACKS
EXPANSION JOINTS
PENSTOCKS, GATES, VALVES—OTHER STEEL FABRICATIONS FOR WATER HANDLING

Above is a partial list of major items. Consult Yuba on related equipment.



LOOK WHAT YUBA MAKES FOR STEAM POWER PLANTS

Electric utilities planning construction of a new steam plant or expansion of present facilities, look to Yuba as a dependable, fully integrated source for all the varied equipment shown here. And for all the skilled services related to its design, engineering, installation or field erection.

Operating nationwide, the divisions and manufacturing plants of Yuba serving the power industry are ideally located to serve you better, providing a single-company responsibility so important in meeting highest product quality standards and delivery requirements—economically.

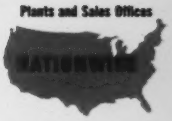
Your inquiries on any or all of these products or services will receive our prompt and careful attention.

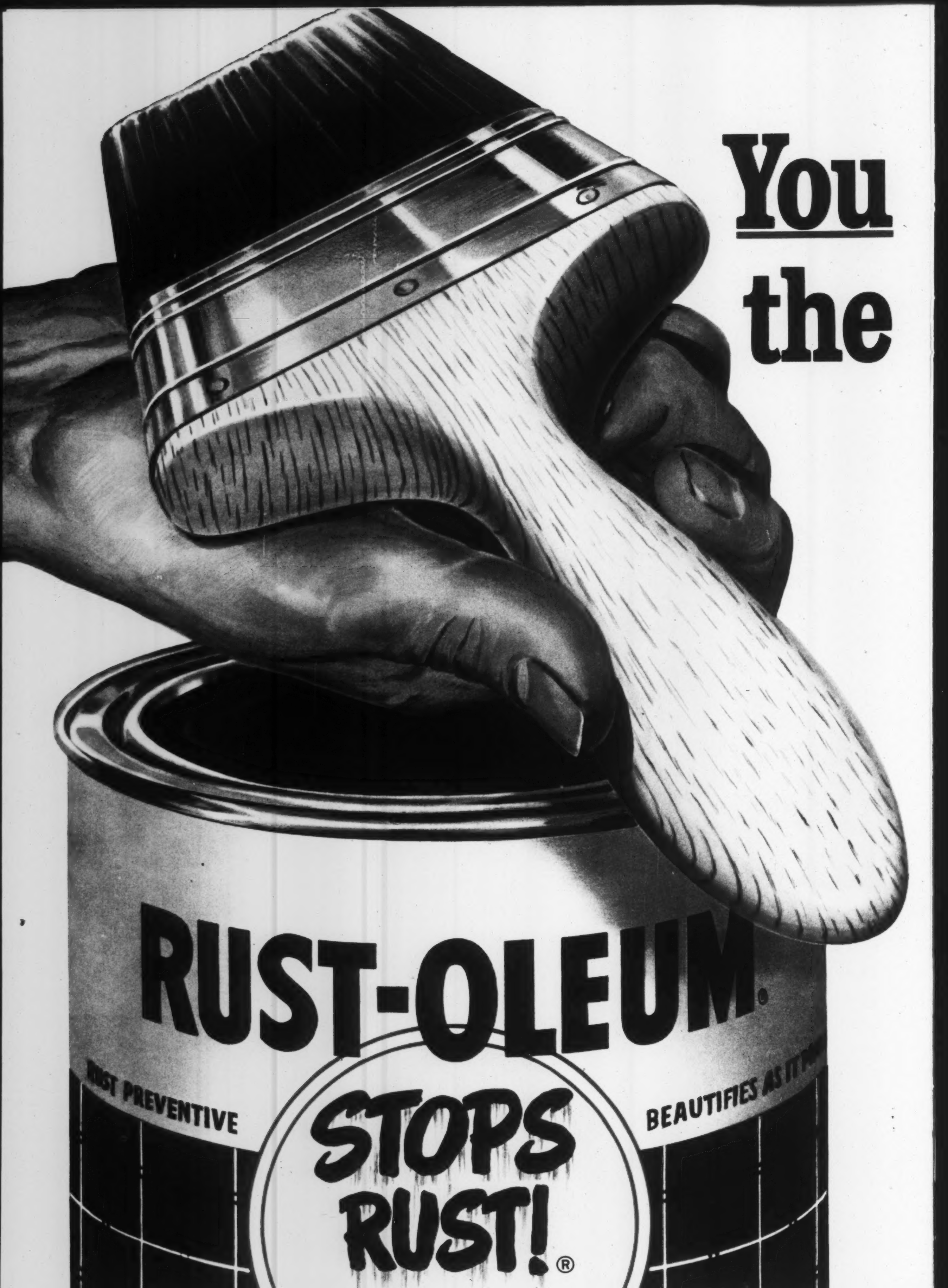
DIVISIONS AND SUBSIDIARIES SERVING THE POWER INDUSTRY: *YUBA HEAT TRANSFER DIVISION, Honesdale, Pa.* • *ADSCO DIVISION, Buffalo, N.Y.* • *YUBA MANUFACTURING DIVISION, Benicia, Calif.* • *SOUTHWEST WELDING & MANUFACTURING DIVISION, Alhambra, Calif.* • *JUDSON PACIFIC-MURPHY DIVISION, Emeryville, Calif.* • *YUBA CONSOLIDATED ERECTORS, INC., San Francisco, Calif.*

YUBA

YUBA CONSOLIDATED INDUSTRIES, INC.
351 California St., San Francisco, Calif.

Plants and Sales Offices


NATIONWIDE


You
the
RUST-OLEUM®
UST PREVENTIVE
BEAUTIFIES AS IT
STOPS RUST!®

take brush!

See the many Rust-Oleum DIFFERENCES yourself!

A few easy strokes of the brush proves more than a thousand words . . . see how smoothly Rust-Oleum flows on . . . no pull, no drag . . . and it dries free of brushmarks. See, too, how much more coverage Rust-Oleum gives you . . . up to 30% more area depending upon the condition and porosity of the surface.

If your metal surfaces are *rusty* – simply brush or spray Rust-Oleum 769 Damp-Proof Red Primer right over the sound rusted metal after scraping and wirebrushing to remove rust scale and loose rust. The *specially-processed fish oil vehicle* in the primer penetrates rust to bare metal–driving out air and moisture. Easy as that to Stop Rust–and save time, money, and metal.

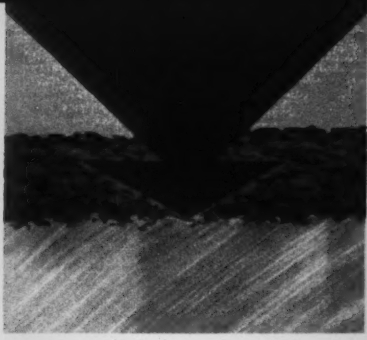
For *lasting beauty* – follow up with a Rust-Oleum finish coating in the color of your choice – from grays, greens, blacks, and aluminums to yellows, blues, whites, or browns – or from the many popular pastel shades.

That is the Rust-Oleum *System* of primer and finish coat for maximum over-the-years protection. A system that is measured by the money you save. Specify Rust-Oleum for maintenance, new construction, and re-modeling. Your Rust-Oleum Industrial Distributor maintains complete stocks for prompt delivery . . . he will be happy to consult with you on your coating problems.

SEE OUR CATALOG IN SWEET'S
OR WRITE FOR COPY

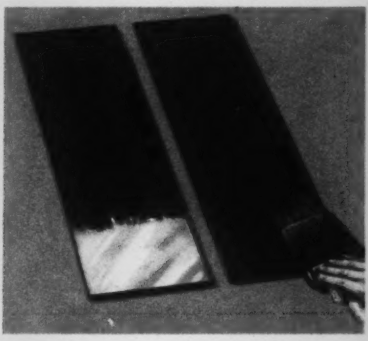
A matter of excellence.
Distinctive as your own fingerprint.

Apply Rust-Oleum 769 Damp-Proof Red Primer directly over sound rusted surfaces. Saves costly surface preparations—lasts and lasts.



The **specially-processed** fish oil vehicle in the primer penetrates rust to bare metal—as proved in radioactive tracing studies.

Rust-Oleum, in its many forms, resists rain, fumes, heat, moisture, sun, and general weathering to stand up over the years.



Up to 30% more coverage with Rust-Oleum, depending upon the condition and porosity of the surface. Another Rust-Oleum difference.

Rust-Oleum primers and finish coatings are easily applied by spray. Flows smoothly . . . may be used in conventional, hot spray, or high pressure air-less spray.

RUST-OLEUM
STOPS RUST!
769
DAMP-PROOF RED PRIMER

What is your coating problem? What **color** do you need? Get lasting beauty in the color of your choice. Mail coupon for color charts.

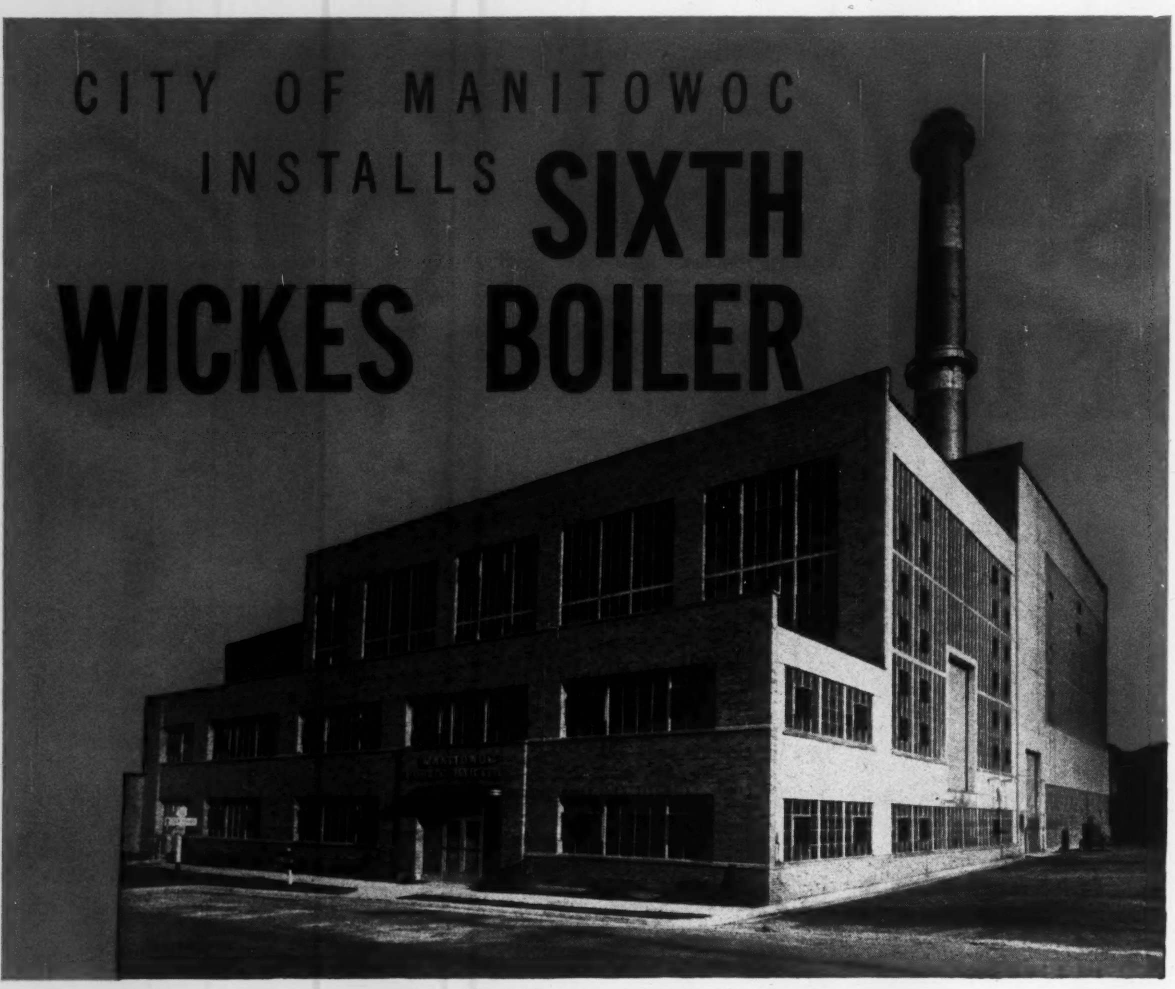
SEND FOR FREE TEST SAMPLE! ATTACH TO YOUR LETTERHEAD!

Rust-Oleum Corporation
2981 Oakton Street, Evanston, Illinois

Please send me the following at no cost or obligation:

- ☐ Free test sample of Rust-Oleum 769 Damp-Proof Red Primer for rusted metal surfaces.
- ☐ Complete literature with applications and color charts.
- ☐ Information on matching special colors.
- ☐ Thirty-page report on Rust-Oleum fish oil penetration.

CITY OF MANITOWOC INSTALLS SIXTH WICKES BOILER



R. E. Connard—Chief Engineer and General Manager

Manitowoc Public Utilities Commission has just installed the sixth Wickes Steam Generator to help provide power for the City of Manitowoc, Wisconsin, and its surrounding area. The continued selection of Wickes equipment by this progressive municipality is a tribute to the dependability and quality of Wickes Steam Generators.

Wickes Boiler Co. builds steam generators for all branches of industry . . . for municipalities and for private and public buildings. Wickes units are available in sizes up to 500,000 lbs. of steam per hour and are designed for high or low steam pressures and temperatures, and for all types of fuels and firing methods. There is a Wickes design available for your needs.

Write for bulletin 55-1, showing the wide variety of designs and sizes available in both field-erected and shop-assembled* steam generators, or ask the nearest Wickes representative to call on you for full information.

*For the latest developments in shop-assembled boilers, investigate Wickes natural circulation A-type water tube units now built for capacities up to 75,000 lbs. per hour for oil and gas fuels. Request bulletins 56-1 and 57-1 for full information.

WICKES BOILER CO.

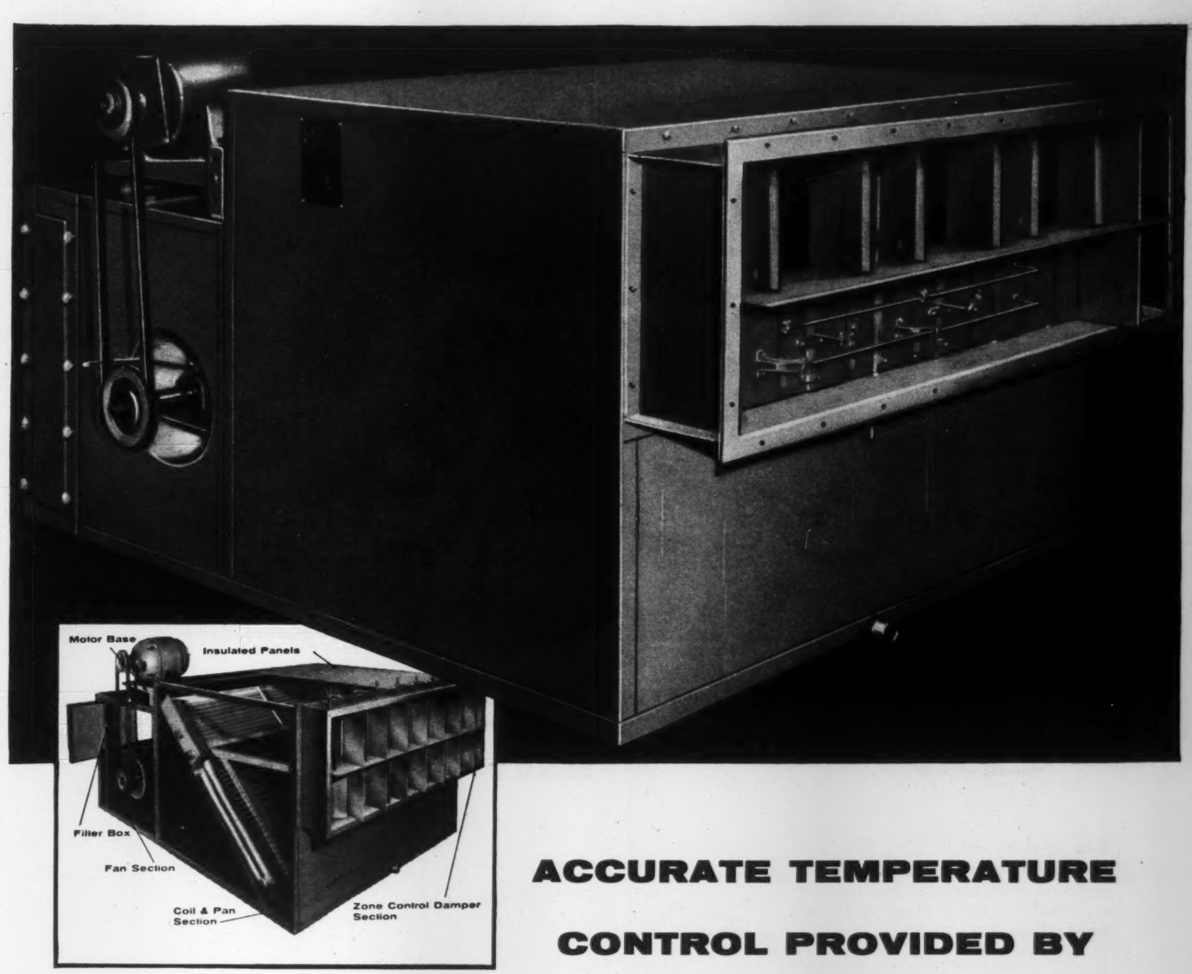
170

WICKES

WICKES BOILER CO., SAGINAW 13, MICHIGAN

DIVISION OF THE WICKES CORPORATION

RECOGNIZED QUALITY SINCE 1854 • ***SALES OFFICES:*** Boston • Chicago Cleveland • Dallas • Denver • Detroit • Houston • Indianapolis • Los Angeles Memphis • Milwaukee • New York City • New Orleans • Portland, Ore. Saginaw • San Francisco • Springfield, Ill. • Tulsa



ACCURATE TEMPERATURE CONTROL PROVIDED BY "BUFFALO" ZONE CONTROL CABINETS

"Buffalo" Zone Control Cabinets are engineered for installations where a single unit must provide varying degrees of conditioned air for several zones or rooms. These quiet operating compact units perform with peak economy, flexibility and dependability.

Temperature is controlled by mixing cooled and heated air in just the right proportions to suit each conditioned space. The need for separate re-heat coils and their controls is completely eliminated. Control for each area can be manual or entirely automatic.

"Buffalo" Zone Control Cabinets are sectionalized for maximum ease of installation. Removable panels and bearings located outside the cabinet simplify servicing. The entire unit is sturdily constructed to insure a long life of maintenance-free operation.

You're sure of satisfactory results when you specify "Buffalo" Zone Control Cabinets. Your "Buffalo" engineering representative will be pleased to provide you with information concerning unit selection, installation, etc. Contact him, or write us direct for Bulletin AC-220.

All "Buffalo" equipment brings you the "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.

BUFFALO FORGE COMPANY
BUFFALO, NEW YORK
Buffalo Pumps Division • Buffalo, N. Y.
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT • EXHAUSTING
FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

The Inquiring Mind at Oldsmobile

no.8 OF A SERIES

THE SOUND . . . AND THE JURY

The quiet, solid feeling inside the 1959 Oldsmobile results from patient testing by a highly specialized "jury"—experts in the field of sound analysis.

Unlike most other phases of automotive engineering, there are no instruments which measure the "annoyance" factor of sounds inside an automobile. Subjective, personal evaluation known as the "jury system" is the most important means of determining how quiet it is inside an Oldsmobile.

With the "jury system", several experienced engineers assemble in an acoustically treated room and listen to binaural tape recordings made inside a test car. Careful editing of the tape recording allows rapid side-by-side comparison between two different test conditions and eliminates reliance on memory since considerable time may elapse between actual tests. By pushing a button, each engineer casts a secret "vote" and then the tabulation of the results determines which test condition is superior.

For the greatest possible accuracy, considerable care is taken making the recordings. Special microphones are placed at points corresponding to the passengers' ears. The recording equipment is in a specially equipped vehicle which follows the test car over a "ride road" that is carefully constructed to excite the vibrations and sounds that occur under normal driving conditions.

Quality, like quietness, is not accidental. It is the deliberate effort by Oldsmobile engineers to *design* quality into every automobile they produce. You'll like the 1959 Oldsmobile—with its solid Body by Fisher—it's the quietest car built! Experience this quality for yourself by visiting your local Authorized Oldsmobile Quality Dealer as soon as possible.

OLDSMOBILE DIVISION
GENERAL MOTORS CORPORATION

OLDSMOBILE **Where Quality is Standard Equipment!**

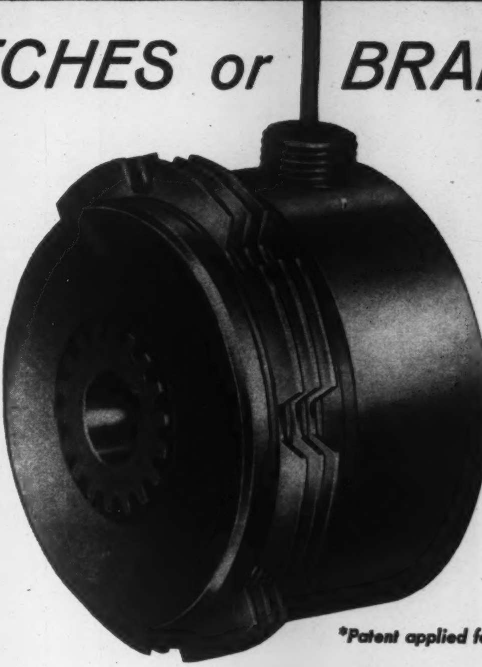
NEW Maxitorq 9000 SERIES*

ELECTRIC CLUTCHES or BRAKES

Featuring these

Advantages:

- **Compact and Simple Design**
- **Built to American Standards**
- **Stationary Coil**
- **No Slip Rings or Brushes**
- **Self-Adjusting—Easily Installed**
- **Drag-free Floating Neutral**
- **No Stressed Levers or Parts**
- **Use as Brake or Clutch**
- **Standard Flange Cups Available**

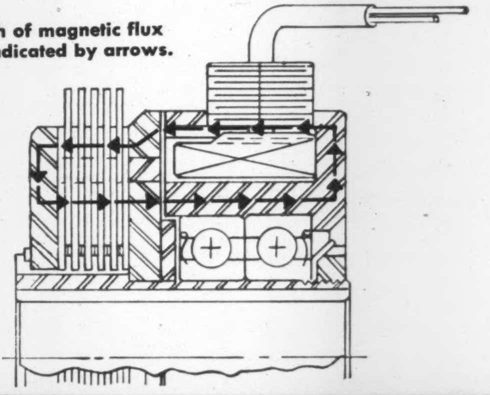


***Patent applied for.**

OPERATION INDUCED ENTIRELY BY *Magnetic Flux*

The new Maxitorq #9000 Series Electric Clutch is a compact, self-contained unit with operation dependent upon induced magnetic flux. As shown in the drawing below, this new Maxitorq Clutch consists essentially of a sealed magnetic coil and housing arrangement actuating multiple discs which also act as the flux path. Because the coil housing, supported on anti-friction bearings, is stationary, troublesome brush and slip ring construction is eliminated. When energized, the entire assembly consisting of pressure plate, inner and outer discs, and buttress plate is locked together by the magnetic force passing through it. When de-energized, Maxitorq separator springs instantly separate the discs creating air gaps which help to break up residual magnetism. Compactness, fast response, and flexibility of control make the #9000 Series clutch or brake ideally suited for a wide range of applications.

Path of magnetic flux is indicated by arrows.



Write, phone or wire Dept. ME now for Bulletin 90 describing the most advanced design of electric cluches or brakes available today.

Let's talk
MAXITORQ

THE CARLYLE JOHNSON MACHINE CO. • MANCHESTER, [illegible] CONN.

pressure seal gate valves . . . made the **POWELL** way

600, 900, 1,500, 2,500 Pounds
and Higher—all commercial sizes

Powell Pressure Seal Gate Valves offer many superior features. A few are:

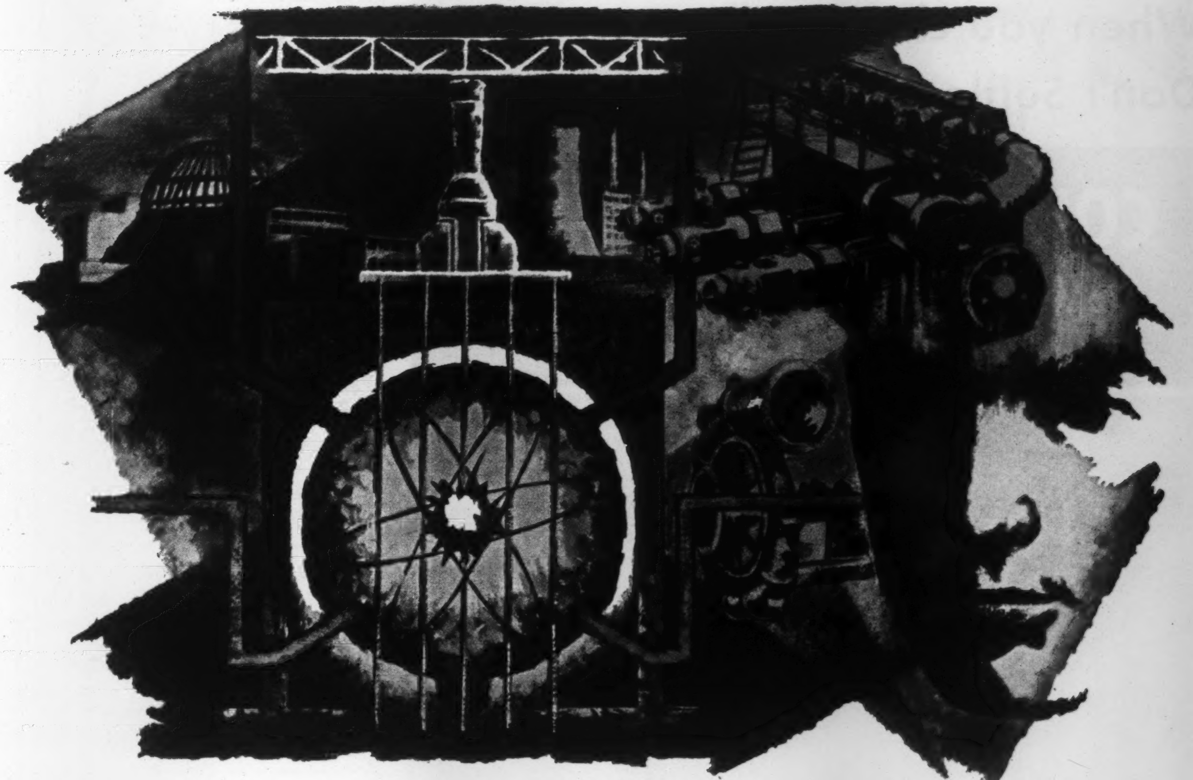
- Streamline flow passage makes possible maximum flow with minimum turbulence.
- Outstanding simplicity of design, smooth body contour and weight reduction assure easier installation, greatly reduced insulating costs, and a marked saving in space.

Powell Pressure Seal Valves are also available in Globe, Angle and Check patterns.

For all your valve needs, consult your local Powell distributor—or write directly to us.

THE WM. POWELL COMPANY
Cincinnati 22, Ohio
Dependable Valves Since 1846

POWELL...world's largest family of valves



In the field of nuclear power as in the oil, gas, chemical and other industries, Dresser "men with imagination" are seeking to create and establish new standards of comparison the world over.

DRESSER
STRIES, INC.

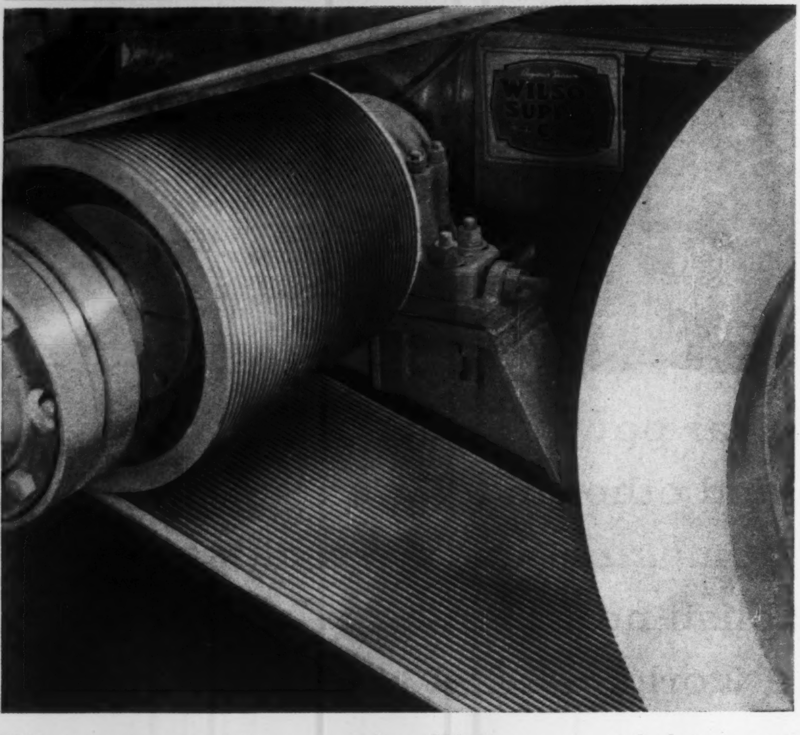
EQUIPMENT
AND TECHNICAL
SERVICES
OIL • GAS • CHEMICAL
ELECTRONIC • NUCLEAR POWER • INDUSTRIAL
REPUBLIC NATIONAL BANK BLDG., DALLAS, TEXAS

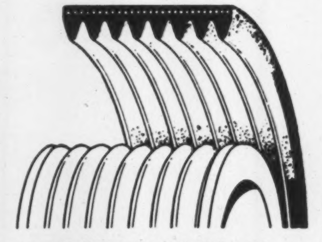
TOMORROW'S PROGRESS PLANNED TODAY
BY MEN WITH IMAGINATION

CLARK BROS. CO.—*compressors & gas turbines* ✣ **DRESSER-IDECO COMPANY**—*steel structures* ✣ **DRESSER MANUFACTURING DIVISION**—*couplings* ✣ **THE GUIBERSON CORPORATION**—*oil tools* ✣ **IDECO, INC.**—*drilling rigs* ✣ **LANE-WELLS COMPANY**—*technical oilfield services* ✣ **MAGNET COVE BARIUM CORPORATION**—*drilling muds* ✣ **PACIFIC PUMPS, INC.**—*pumps* ✣ **ROOTS-CONNERSVILLE BLOWER DIVISION**—*blowers & meters* ✣ **SECURITY ENGINEERING DIVISION**—*drilling bits* ✣ **SOUTHWESTERN INDUSTRIAL ELECTRONICS**—*electronic instrumentation* ✣ **WELL SURVEYS, INC.**—*nuclear and electronic research and development.*

When you change drives...
Don't Settle for *Less* than the BEST

CONVERT TO RELIABLE R/M POLY-V® DRIVE!

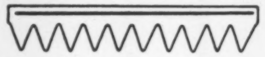




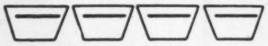
- **ELIMINATES "MATCHING" PROBLEMS**

A SINGLE UNIT across full width of sheave—NOT an assembly of SEVERAL V-BELTS

Poly-V

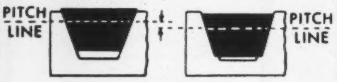


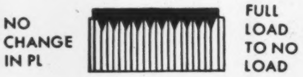
V-Belts



- **MORE UNIFORM POWER**
- **IN LESS SPACE**

Uninterrupted strength member full width of sheave provides higher horsepower capacity with less stretch —in less space.





- **MAINTAINS GROOVE SHAPE**
- **COMPLETE CONTACT-PRESSURE**
- **MORE CONSTANT SPEED RATIO**

Sheave grooves do not wear out of shape. Full and complete contact-pressure of rubber-to-sheave maintains groove profile. Maintains constant pitch and speed ratio.

..."MORE USE PER DOLLAR"

This gas compressor drive was rough on V-belts . . . until Wilson Supply Company installed trouble-proof R/M Poly-V Drives on all 200 HP units. Today, R/M's patented, space-saving transmission drive assures a degree of power-packed performance and dependability not possible with any available V-belt drive!

Major causes of V-drive trouble are engineered *out* of Poly-V Drive. It features a single unit, V-ribbed belt—*not* an assembly of V-belts that become unmatched and prevent complete power delivery. Full contact between Poly-V Belt ribs and specially designed sheave grooves keeps belt position constant . . . maintains groove shape and profile regardless of wear—with less wear on belt and sheaves even under toughest drive conditions! Speed ratio is unchanged. And because Poly-V Belt has uniform, uninterrupted strength member across the sheaves, Poly-V Drive will reliably deliver up to 50% *more* power in the same space as a multiple belt drive—or equal power in as little as ⅔ the space!

Let an R/M representative show you how Poly-V* Drive can give you more power delivery, more drive dependability . . . "More Use per Dollar" than the drive you now use. Just two cross sections of Poly-V Belt meet every heavy duty power requirement. Write for Bulletin M141.

WHEN YOU CHANGE DRIVES...CONVERT TO R/M POLY-V DRIVE AND BE SURE!

*Poly-V is a registered Raybestos-Manhattan trademark.

RM-954

BELTS • HOSE • ROLL COVERINGS • TANK LININGS • INDUSTRIAL RUBBER SPECIALTIES

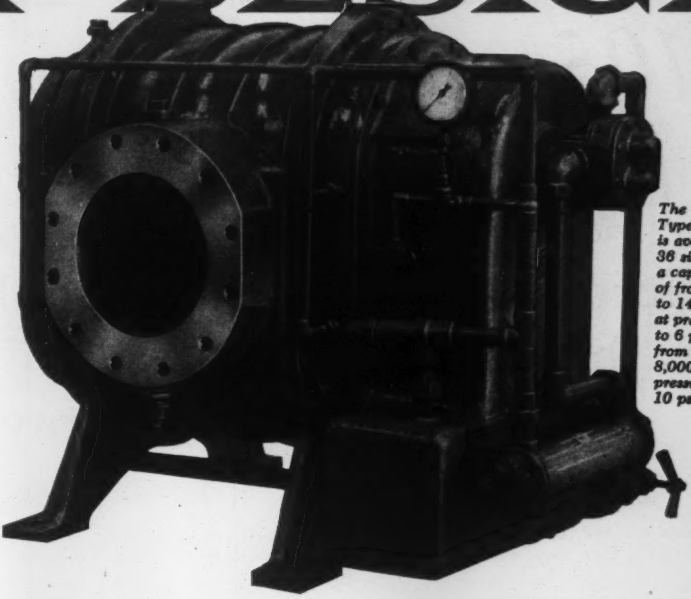
MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products: Abrasive and Diamond Wheels • Brake Blocks and Linings • Clutch Facings • Asbestos Textiles • Mechanical Packings • Engineered Plastics • Sintered Metal Products • Industrial Adhesives • Laundry Pads and Covers • Bowling Balls

NEW-DESIGN

R-C blower delivers more CFM



The new R-C Type RAS Blower is available in 36 sizes covering a capacity range of from 2,000 to 14,000 cfm at pressures to 6 psig and from 1,500 to 8,000 cfm at pressures to 10 psig.

AT LOWER POWER COST

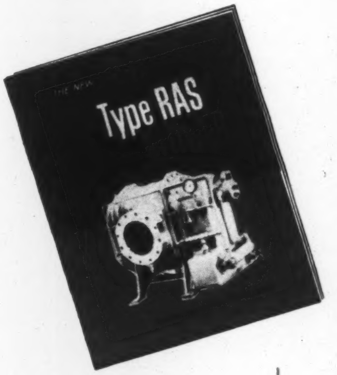
A new, high-performance R-C rotary positive blower (designated Type RAS) features two important design improvements. *First,* a new "segment waist" impeller contour that increases the volumetric efficiency of the blower. *Second,* a new vertical arrangement of the impellers that increases application flexibility.

The design of the "segment waist" impeller contour permits a higher pressure rating for a given impeller length. This in turn delivers greater displacement per revolution without increasing operating speed and at a lower power cost. And, in addition to being more quiet in operation, the design permits safe handling of entrained liquids.

The vertical arrangement of the impellers provides horizontal inlet and discharge connections for more convenient, simplified piping. Extremely compact, the blower also offers substantial savings in space requirements. And, as with all R-C rotary positive blowers, air delivered is free from oil vapors and other contaminants.

Roots-Connersville RAS blowers offer many advantages—exclusive rotary positive design, ease of installation, efficiency of operation, and long years of trouble-free service. These features are the result of R-C's specialized experience of more than 100 years in the design and application of air and gas handling equipment.

For gas service too...This same new design is also available in pumps for gas service. Designated Type RGS, the gas pumps differ from Type RAS Blowers only in that a mechanical face type seal is used instead of a lip seal.



For additional data, please refer to pages 565-568 in **Chemical Engineering Catalog,** *our section in* **Mechanical Catalog,** *or write for* **Bulletin RAS-158.**

ROOTS-CONNERSVILLE BLOWER
DIVISION OF DRESSER INDUSTRIES, INC.
359 Michigan Ave., Connersville, Indiana. In Canada—629 Adelaide St., W. Toronto

The Case For 105mm Miniaturization of Engineering Drawings

Micro-Master® 105mm, supplied by K&E, is the only system designed specifically for engineering drawings

Micro-Master 105mm offers the general advantages you expect of any miniaturization system – space savings, protection of costly originals, and ready distribution of duplicates. But Micro-Master provides these advantages *without* over-mechanization. A 105mm negative – measuring a generous 4 by 6 inches – is large enough to be located easily and read quickly without elaborate scanning and sorting devices. In addition, a national network of K&E dealers stands ready to provide the 105mm service you need.

A Complete System from Film to Print

Micro-Master is a totally integrated system for photographing, film processing and final reproduction or projection printing. Completely precision-engineered – from optics through films, papers and chemicals – the system provides extremely sharp, high-contrast "thin" negatives that furnish high-quality, absolutely uniform prints. Critical alignment of camera and projector, and special vacuum frames which hold materials absolutely flat, are typical of the optical and mechanical features that make the Micro-Master system an engineering aid of highest quality.

No Distortion in Blow-Backs

Maximum reduction or enlargement for Micro-Master 105mm is 10 diameters –not up to 30 diameters as with smaller negatives. Thus, when drawings as large as 40 by 60 inches are reduced or re-enlarged, they retain a clear, sharp quality – even in the corners. There is no distortion or loss of detail, for all Micro-Master reproductions are made inside the photographic "quality barrier" of 10 diameters. Projection prints can be made on inexpensive paper as well as on cloth or film.

Like-New Prints from Worn Originals

Old originals can be restored, too – even when badly damaged. The Micro-Master process uses *reflected* rather than transmitted light. Thus, detail which has been lost through light absorption – due to dirt or discoloration – will "snap back" on the film – giving you clean prints with clear backgrounds and sharp black lines equal to ink lines. The large negative size makes it easy to see and eliminate unwanted areas by "opaquing out." Any small paint brush can be used for this purpose.

Easy to Read . . . Always Accessible

You can read almost every detail on a 105mm negative just by holding it up to a window or other light source. Table viewers are recommended for close study, but are *not necessary* in the "search and selection" phase. In a large plant or office, engineers can find and consult from 105mm negatives without waiting for search and delivery of originals, and without having to blow back tiny reductions to a readable size. Engineers or technicians at branch plants, warehouses or field installations can maintain compact, complete files of project information – accessible at any time without special equipment.

Easy to File, Easy to Mail

Micro-Master is a miniaturization system providing *individual* negatives that meet archival requirements. Each negative is kept in its own 5″ by 8″ envelope. There is ample space on the envelope for large, legible identification coding and other information. Over 12,000 drawings can be stored in a standard 5″ by 8″ card file cabinet. No complicated cross-indexing is needed, for negatives of original drawings and all subsequent revisions can be grouped in the same file, ready for immediate reference. The absence of sorting devices eliminates scratches and other film damage resulting from excessive mechanical handling.

See Your K&E Dealer for Information, Equipment, Service

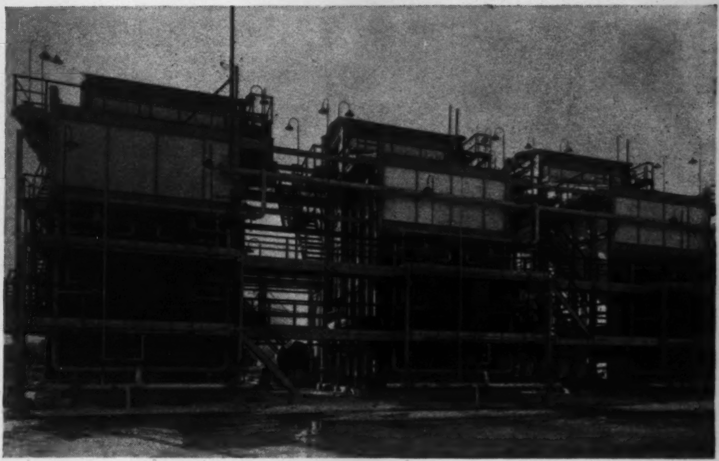
A camera, projector, three types of viewers, and all necessary printing accessories are available with the Micro-Master system, and all equipment can be obtained through your local K&E distributor. He can also furnish 105mm reductions and enlargements of your drawings as a service. For complete information, call your K&E dealer, or write to Keuffel & Esser Co., Dept. ME-3, 300 Adams St., Hoboken, N. J.

1634

K+E

KEUFFEL & ESSER CO.

NEW YORK • HOBOKEN, N. J. • DETROIT • CHICAGO • MILWAUKEE • ST. LOUIS • DALLAS • SAN FRANCISCO • LOS ANGELES • SEATTLE • MONTREAL



AT LEFT: Installing a 60,000 lbs/hr unit in a brewery

ABOVE: A battery of 125,000 lbs/hr units in a chemical plant

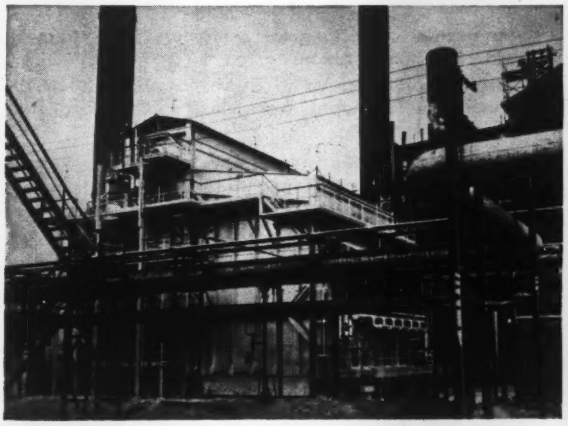
CUSTOM Steam GENERATORS by Vogt

Vogt engineering advances can save you money if you have a steam generating problem. Custom-built installations shown, are engineered to assure efficient, dependable steam generation for power, process and heating. Our engineering staff is available to give effective help in the solution of steam generating problems peculiar to a wide variety of operating conditions. Address Dept. 24A-BM.

Vogt
FOR BETTER
BOILERS

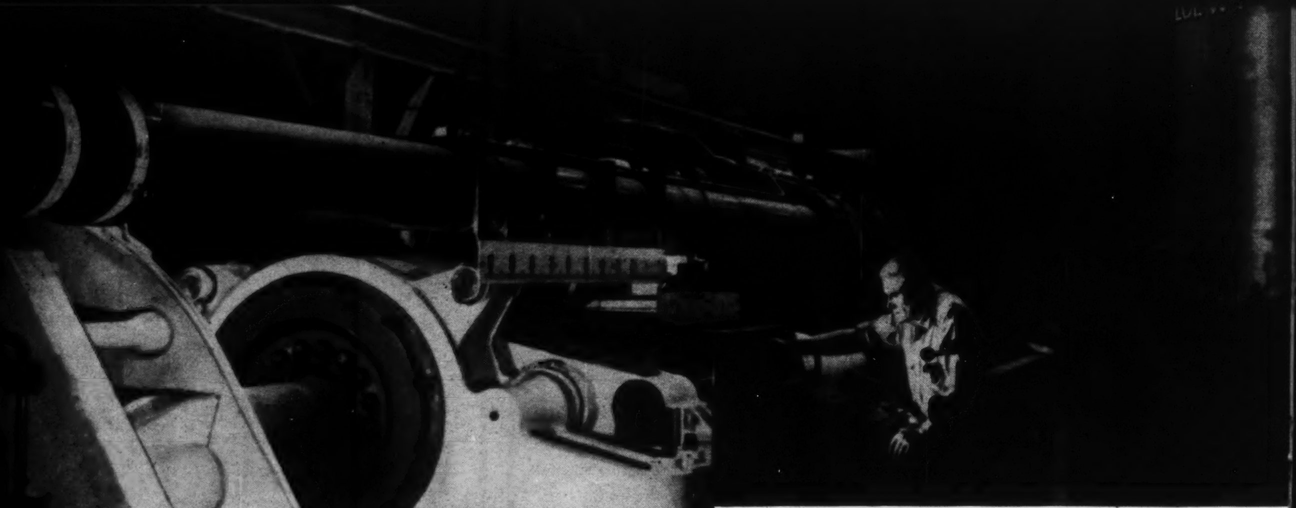
HENRY VOGT MACHINE CO.
LOUISVILLE, KENTUCKY

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati

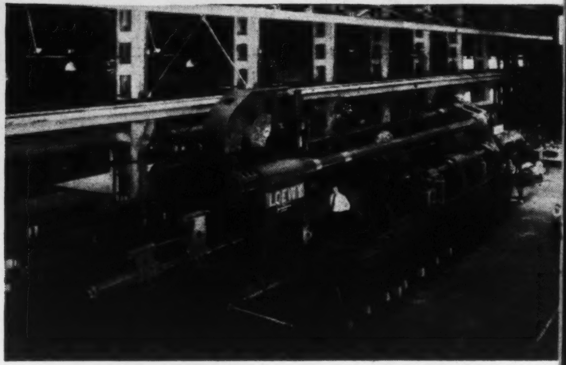


This 400,000 lbs/hr unit is installed in a leading petroleum refinery

Three 40,000 lbs/hr units serve a medical center



Designed and built by Loewy-Hydropress, this 6000-ton hydraulic extrusion press for light metals and steel is seen in operation at Reynolds Metals' Phoenix, Ariz., plant.



90-ft.-long extrusion press on erection floor.

New and highly automated extrusion press is 10th by Loewy in Reynolds' nationwide organization

Flexibility, power, speed, precision . . . these are the characteristics of a highly automated 6000-ton-capacity extrusion press designed and built by Loewy-Hydropress for the U.S. Navy and operated by the Reynolds Metals Company, America's second largest producer of aluminum.

This new press is designed for maximum concentricity and for easy change from low to high speed without change of valves. One important feature is that it permits changing over quickly from working aluminum to working steel and titanium.

On this Loewy press, substitution of containers, which in conventional extrusion presses requires many hours, can be done in 30 minutes or less. A further feature is a mandrel mover that can be stopped independently of the press movement, and that holds the mandrel stationary in relation to the die. This makes it possible to extrude shapes of unusual design, such as small, hollow configurations which can only be made with specially shaped mandrel tips. A unique device provides for the handling of split dies for step extrusion.

Other features of this advanced Loewy press are these:

- Automated constant speed control
- Automated billet loading system
- Semi-automatic butt and dummy block handling device
- Application of rectangular containers for extremely wide and thin extrusions
- Extrusion of billets up to 50 in. long and 20 in. in diameter into shapes more than 100 ft. long and 16 in. in diameter

Striking evidence of customer satisfaction with Loewy presses is the fact that this machine is the tenth designed and built by Loewy-Hydropress for Reynolds. The same engineering skills that produced it will go to work in your service no matter how large or small the equipment you need. Simply write us at Dept. F-3.

Loewy-Hydropress Division
BALDWIN · LIMA · HAMILTON
111 FIFTH AVENUE, NEW YORK 3, N.Y. Rolling mills • Hydraulic machinery • Industrial engineering

4-D

WROUGHT IRON PIPE

SOIL WASTE VENTS DOWN-SPOUTS

4-D represents the most significant development in the history of wrought iron metallurgy. It was achieved by substantially increasing the deoxidation of the base metal, slightly increasing the phosphorous content and using a more siliceous iron silicate. Result is increased corrosion resistance, improved physical and mechanical properties.

Combats Corrosion

4-D Wrought Iron Pipe is an aggressive deterrent to corrosion failures in drainage systems. The permanence and durability of 4-D Wrought Iron Pipe increase the value of any building. 4-D's piping permanence is especially important where inaccessibility makes replacement and repair a major expenditure for the owner.

Saves Space

To save space, many designers favor Durham Systems with 4-D Wrought Iron. Such systems eliminate weak and bulky lead-wiped joints, and enable longer runs without damage from building settlement, vibration, or wide temperature variations. And 4-D Wrought Iron Pipe meets building code requirements.

Installs Easily

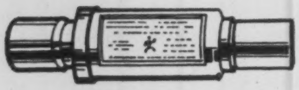
4-D's availability in long random lengths results in fewer joints, fewer supports, and less labor costs. And there's less weight involved with 4-D Wrought Iron Pipe. When corrosion resistance and strength are factors, 4-D's cost story is easier to substantiate than that of clog-prone, extra-heavy piping materials.

Outlasts Ordinary Metals

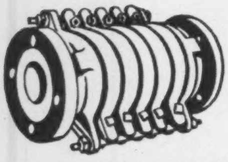
Ultimate service life of any piping material in any piping service depends upon its quality and its composition. Thousands of non-rusting iron silicate fibers, uniformly distributed in a highly refined base metal, make 4-D unique in its ability to resist corrosion. There's nothing finer. There's no "or equal." And due to its microscopically rougher surface, which is accentuated by pickling, 4-D Wrought Iron takes up to a 50% tighter, heavier galvanized coating than other metals.

Need proof? Write for 4-D Wrought Iron literature and test results. A. M. Byers Company, Clark Building, Pittsburgh 22, Pennsylvania.

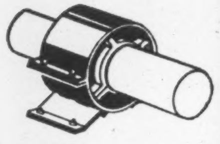
BYERS 4-D WROUGHT IRON



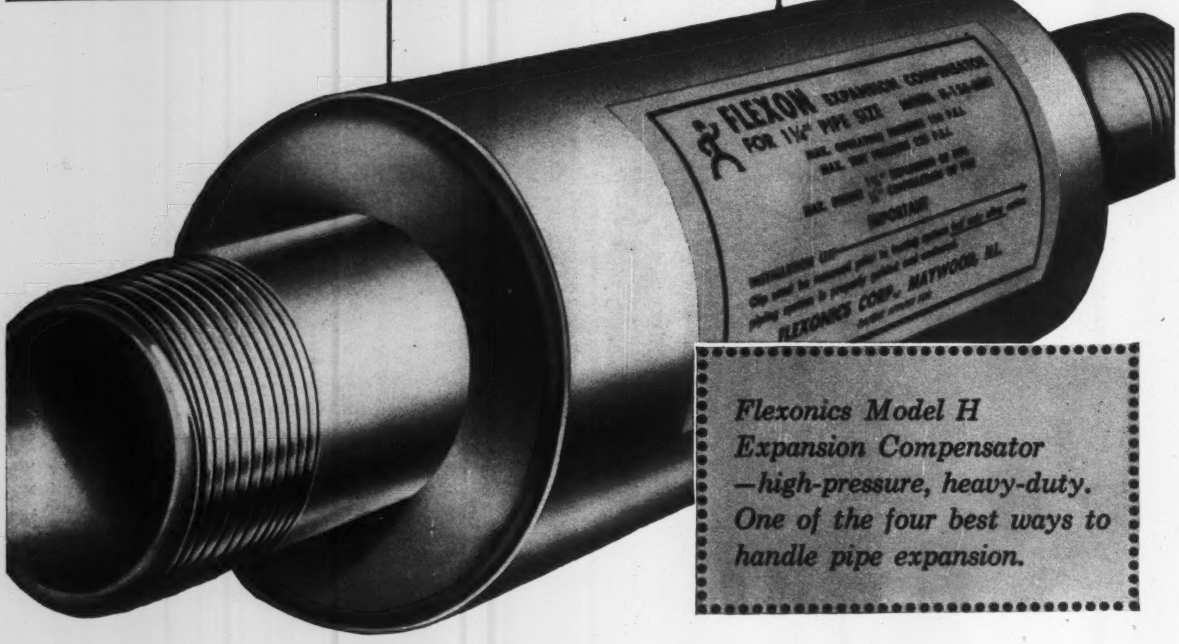
Flexonics Model L Expansion Compensator — to handle pipe and tubing motion up to ½" in low-pressure heating systems.



Flexonics Expansion Joints — controlled-flexing, free-flexing, and many special types, in an unlimited range of sizes.



Flexonics Pipe Guides — a completely new and better way to keep pipe in alignment. Positive, rugged, inexpensive.



Flexonics Model H Expansion Compensator —high-pressure, heavy-duty. One of the four best ways to handle pipe expansion.

INCH FOR INCH, THE LOWEST-COST WAY TO TAKE UP PIPE EXPANSION

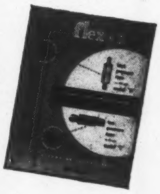
Any way you look at it, the Flexonics Model H Expansion Compensator *costs less* — costs less per inch of stroke than any other way to handle pipe motion — costs less after it's installed because it never needs maintenance.

Yet the Model H is built for hard service. Its 2-ply stainless steel Flexonics bellows is designed to outlast the building. Steel-encased and heliarc welded for full protection from external damage. Positive internal guide and anti-torque device. Completely packless. No servicing necessary after installation.

These are the reasons why engineers and piping contractors are specifying the Flexonics Model H for thousands of industrial piping jobs that use pipe up to 3" and require up to 2" total movement at each Expansion Compensator. Working pressures to 175 p.s.i. for ¾" and 1" sizes; to 125 p.s.i. for larger sizes up to 3".

Make the Flexonics Model H Expansion Compensator a cost-cutting part of your next piping job.

Today—write for informative and helpful Catalog No. 163R.



EC-130

TOMORROW'S
ENGINEERING
TODAY

Flexonics

EXPANSION COMPENSATORS

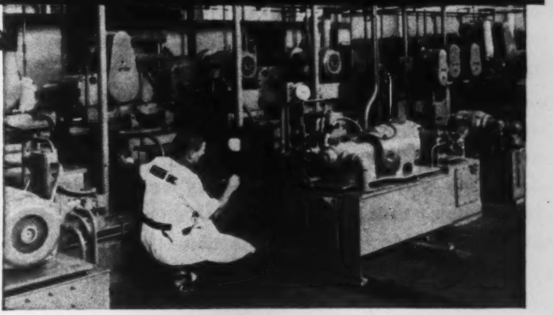
FLEXONICS CORPORATION • 1305 SOUTH THIRD AVENUE • MAYWOOD, ILLINOIS

Divisions
INDUSTRIAL HOSE • EXPANSION JOINT • BELLOWS • AERONAUTICAL • AUTOMOTIVE
Flexonics Research Laboratories, Elgin, Illinois
In Canada: Flexonics Corporation of Canada, Limited, Brampton, Ontario

Immediately Available...
When and Where you need them

VICKERS®
Hydraulics

- **WAREHOUSE STOCKS***
- **REPAIR FACILITIES**
- **FIELD SERVICE**



Overnight Service Anywhere

- **Chicago**
  1029 So. Kildare
  NEvada 8-0101
- **Detroit**
  1400 Oakman Blvd.
  TOwnsend 8-5100
- **Los Angeles**
  2160 E. Imperial Hwy.
  (El Segundo, California)
  ORegon 8-2503
- **Seattle**
  623 Eighth Ave., South
  MUtual 2-6950
- **Springfield (N. J.)**
  51 Springfield Ave.
  (Newark Proximity)
  DRexel 6-3500
- **Toronto**
  Vickers-Sperry of Canada, Ltd.
  92 Advance Road
  BElmont 2-1191

- **Stock Units and Parts***
- **Repair or exchange of Units**—promptly—tested to factory specifications
- **Testing facilities**
- **Field service**—other Field Service Headquarters locations listed below (underlined)

*Applies to standard Industrial line products and selective Mobile products—Aircraft products are not included.

VICKERS INCORPORATED
DIVISION OF SPERRY RAND CORPORATION
Machinery Hydraulics Division
ADMINISTRATIVE and ENGINEERING CENTER
Department 1500 • Detroit 32, Michigan

Application Engineering Offices: ATLANTA • CHICAGO* • CINCINNATI • CLEVELAND • DETROIT* • GRAND RAPIDS • HOUSTON • INDIANAPOLIS • LOS ANGELES AREA (El Segundo)* • MILWAUKEE • NEW YORK AREA (Springfield, N.J.)* • PHILADELPHIA AREA (Media) • PITTSBURGH AREA (Mt. Lebanon) • PORTLAND, ORE. • ROCHESTER • ROCKFORD • SAN FRANCISCO AREA (Berkeley) • SEATTLE* • ST. LOUIS • WORCESTER • Factories also in: Australia, England, Japan and Germany • In Canada: Vickers-Sperry of Canada, Ltd., Toronto,* Montreal and Vancouver

Field Service Headquarters Underlined. Whse. Stock & Repair Branches*.

8154A

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

A plant built on the philosophy of "don't accept anything at face value"...

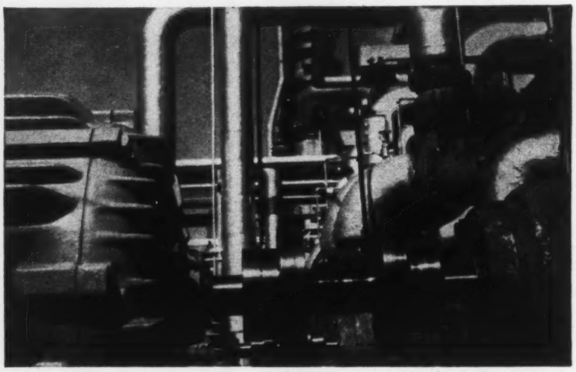
Tidewater's "Refinery of the Future" Uses 471 Fast's Couplings to Reduce Maintenance

IN PLANNING Tidewater's Delaware Refinery, all equipment purchases were examined from every angle . . . capital investment, manpower, maintenance and reliability. Fast's Self-Aligning Couplings were used throughout because they met Tidewater's exacting demands.

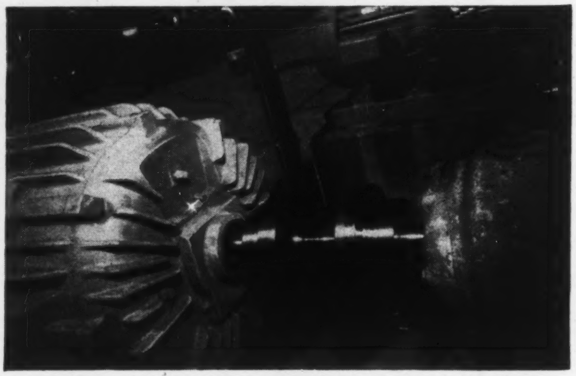
Tidewater's equipment design policies were established by survey teams that visited refineries all over the country. They carefully appraised each plant and asked operators what improvements they would make and what features they would retain if they were to redesign their drives.

In 471 applications at this refinery, Fast's Couplings guarantee mechanical flexibility that eliminates costly shutdowns and expensive shaft replacements. Fast's have the reputation of frequently outlasting the equipment they connect. This means savings in maintenance and down-time . . . in addition to protecting costly equipment against errors of alignment.

Nearly 40 years of coupling experience qualifies Koppers to solve *your* coupling problem. Write today for full details to: KOPPERS COMPANY, INC., Fast's Coupling Dept., 5703 Scott Street, Baltimore 3, Md.



Fast's Couplings give dependable, trouble-free service throughout Tidewater's entire production facilities.



This Fast's Coupling drives a pump delivering heavy naptha to the Solutizing plant.

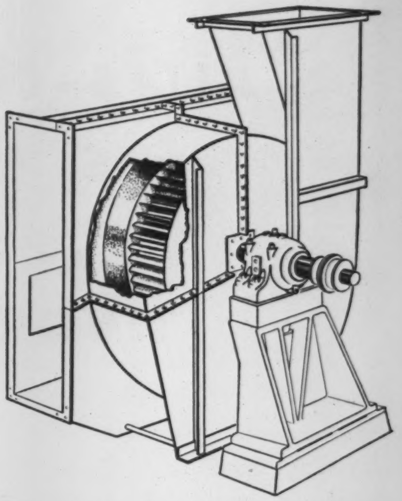
Engineered Products
Sold with **Service**

KOPPERS

THE ORIGINAL

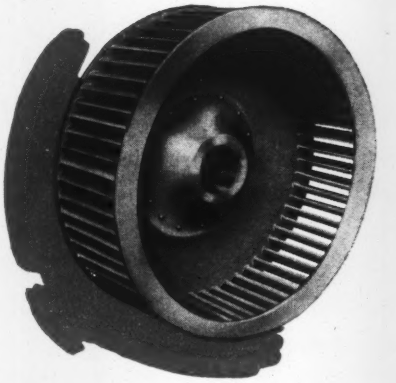
FAST'S Couplings

This is Freeport Sulphur's first-in-the-world offshore sulphur mining plant in Gulf of Mexico, off the Louisiana coast.



This is Green's MC type fan, 4 of which were supplied to Freeport Sulphur—each with 54" wheel, producing 67,800 CFM against 18" S.P. at 715°.

FREEPORT SULPHUR'S doing it for the first time in the world! and Green MC type fans will help this gigantic air lift!



Freeport Sulphur had a tough engineering problem.

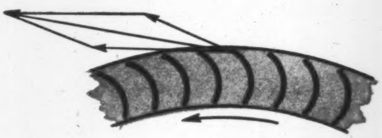
For their world's first offshore sulphur mining operation, Freeport Sulphur has to compress truly tremendous air volume to air lift liquid sulphur to the surface. Fans are needed for the steam operating unit compressing this air.

Rugged, dependable fans are required. Also, fans that need but a minimum of working space.

Where did Freeport Sulphur get such fans?

Easy — they ordered Green MC type fans. These fans are not only rugged, but the MC is the smallest fan that can be used to perform any required job.

You, too, might solve a vexing engineering problem by calling on Green.



It's the forward curve at BOTH tip and heel of fan blades that does the job on Green MC type fans.

Green

THE GREEN FUEL ECONOMIZER CO., INC.,

BEACON 3, NEW YORK

ALLIS-CHALMERS ACQUIRES S. MORGAN SMITH ...FORMS NEW HYDRAULIC DIVISION

On February 1, the S. Morgan Smith Company became a part of Allis-Chalmers. Extensive A-C facilities in Milwaukee, together with two S. Morgan Smith plants in York, Pennsylvania, are now operating as the newly created Allis-Chalmers Hydraulic Division.

In acquiring S. Morgan Smith, A-C combines its own broad background in hydraulics with the 80 years of diversified engineering and manufacturing knowledge of SMS.

The York facilities will be devoted to the continued research, design, engineering and fabrication of a complete line of hydraulic turbines and accessories, pumps and pump-turbines, valves for industrial, waterworks and power applications, and specialized heavy equipment.

Product information or engineering help can be obtained from your nearby Allis-Chalmers office, or by writing Allis-Chalmers, Hydraulic Division, York, Pennsylvania.

HYDRAULIC DIVISION

RESEARCH DESIGN
HYDRODYNAMICS
ENGINEERING FABRICATION

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

A-C ALLIS-CHALMERS **ALLIS-CHALMERS**

LADISH

Controlled Quality

LIGHT WEIGHT
WELDING NECK
FORGED FLANGES
125 POUND

LADISH 4" 125 WOE

Reduce cost... eliminate breakage of cast flanged-end piping components when bolting to steel welding neck flanges

POSITIVE, LEAK-TIGHT JOINTS

Proven design principle of raised face flange has been adapted to assure a completely safe, positive connection to class 125 cast iron flat face flanges.

ELIMINATES NEED FOR HEAVY FLANGED ENDS ON VALVES AND PUMPS

No longer is it necessary to pay a premium to obtain the heavier flanged end valves, pumps and other piping components required to withstand bolting to raised face steel flanges in a welded piping system.

LOW WEIGHT—AMPLE STRENGTH

Light cross section design reduces weight to 30-50 per cent of ASA 150 pound Welding Neck Flange . . . still possesses ample strength to assure safe, leak-tight joint with mating cast flange.

LOWER COST

Savings in purchase price of Light Weight flanges are supplemented by additional savings realized by selecting valves on the basis of pressure rather than strength characteristic of flanged ends.

EASE OF INSTALLATION

Adequate welding neck type hub length keeps welding heats safely from flange. Prevents unpredictable warpage and deformation. Light weight facilitates handling, speeds positioning and installation.

MINIMIZES PIPEFITTER PRECAUTIONS

Safe and suitable for use with either carbon or alloy steel bolting . . . either full face or ring gaskets, in 1/16" or 1/8" thicknesses.

PRESSURE-TEMPERATURE RATING

Rating corresponds to ASA B16.1 class 125 cast iron flanges . . . 125 PSI (gauge) saturated steam; 175 PSI (gauge) water, oil or gas at 150° F.

SERVICE APPLICATIONS

Widely accepted for low pressure piping in gas distribution service . . . utility services such as water, heating, air conditioning, refrigeration . . . pumps and compressors.

L

TO MARK PROGRESS

PIPING PROBLEM:

(1) Difficulty experienced in making pressure tight connection with flat face flanges with full face gaskets.

(2) Breakage of relatively brittle cast iron flanged ends on valves, pumps and other piping components when bolted to standard 1/16" raised face steel flanges.

LADISH SOLUTION:

The 125 pound Light Weight flange developed by Ladish is an ideal solution to this problem . . . for not only does it solve the problem . . . but it provides significant additional advantages of cutting purchase costs and reducing weight.

You can depend on Ladish for leadership in introducing piping developments to reduce cost and improve service.

A national network of distributors, Ladish plants and sales offices is ready to serve you.

Specification sheets on Light Weight Flanges and Welding Fittings available on request.

L

TO MARK PROGRESS

LADISH CO.

CUDAHY (Milwaukee Suburb) WISCONSIN

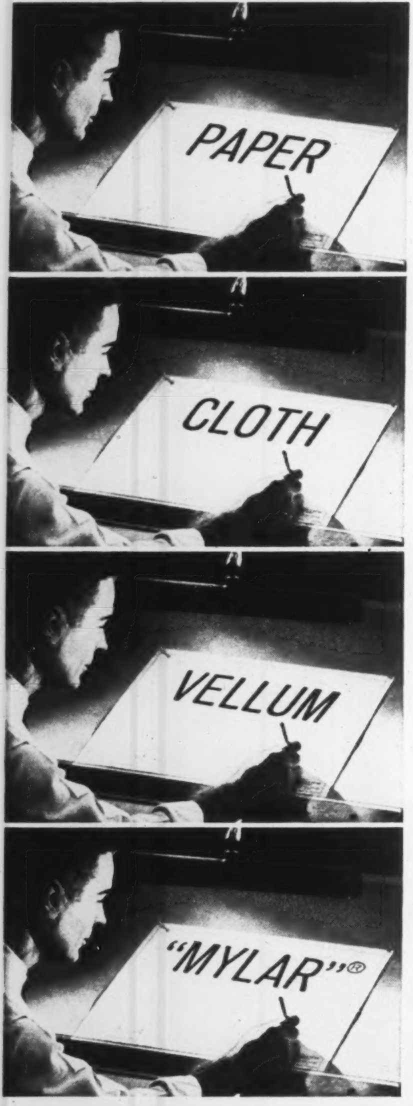
SALES OFFICES: Amarillo • Atlanta • Baton Rouge • Buffalo • Calgary
Chicago • Cincinnati • Cleveland • Denver • Havana • Houston • Los Angeles
Mexico City • Montreal • New York • Odessa • Philadelphia • Pittsburgh
St. Louis • St. Paul • San Diego • San Francisco • Seattle • Toronto • Tulsa

SAW BLADES • PIPE FITTINGS • DROP FORGINGS • RINGS • VALVES

LADISH . . . THE FITTINGS LINE THAT OFFERS COMPLETE SERVICE IN TYPES, SIZES AND MATERIAL SPECIFICATIONS

WELDING FITTINGS	ASA & MSS FLANGES	SCREWED & SOCKET FITTINGS & UNIONS	LONG NECKS	LARGE DIAMETER & T.E.M.A. FLANGES

On any drafting material...


PAPER
CLOTH
VELLUM
"MYLAR"®

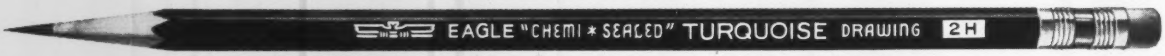
You draw sharper, clearer with Eagle Turquoise

MADE U.S.A. EAGLE TURQUOISE 3379

TURQUOISE LEAD HOLDERS hold any TURQUOISE lead (5B to 9H) in a bulldog grip.

EAGLE "CHEMI ✱ SEALED" TURQUOISE DRAWING 2H

TURQUOISE DRAWING PENCILS are made in 17 degrees, 6B to 9H.


EAGLE "CHEMI ✱ SEALED" TURQUOISE DRAWING 2H

TURQUOISE WITH ERASER, in grades 4B to 6H, is increasingly popular as a field tool.

We've run tests on every drafting material made—including some that aren't even on the market yet! On all of them, TURQUOISE consistently out-performs other pencils.

Here's why: the strong TURQUOISE needle-point stays sharp longer. You get the world's cleanest lines—for the world's sharpest reproduction. TURQUOISE'S "electronic" graphite glides more smoothly (without skipping) over every material. And these superior qualities are combined with perfectly uniform grading—pencil after pencil!

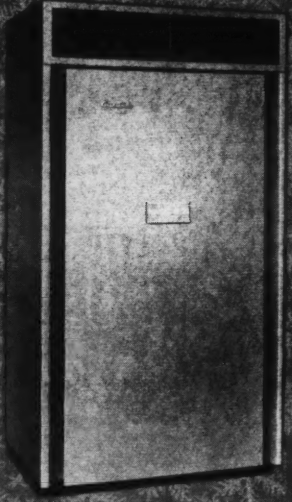
So why switch pencils when you switch drafting surfaces? Standardize on Eagle TURQUOISE!

WANT A FREE SAMPLE? Write for a TURQUOISE lead, pencil, or pencil-with-eraser in the degree you'd like to test on your favorite drafting material. Eagle Pencil Company, Danbury, Conn.

EAGLE ®

Curtis

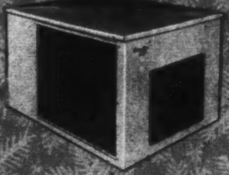
CONDITIONS COMMERCIAL AMERICA...



Curtis packaged units minimize floor area required. Factory assembled and tested. Field installation requires only setting and connecting utilities.

PACKAGED AIR CONDITIONERS UP TO 100 TONS.

AIR-COOLED UNITS UP TO 16 TONS.



PACKAGED LIQUID CHILLERS UP TO 100 TONS.

PRECISION

close tolerance manufacturing, builds peak performance into every CURTIS unit.

Curtis is the "luxury line" in the air-conditioning industry. Silence, efficiency and long-life are inherent in Curtis design.

Yet Curtis prices are right in line.

This is why Curtis designs and builds thousands of unique air conditioning systems for commercial America . . . why Curtis is able to maintain a family of over 300 representatives and servicing contractors across the nation.

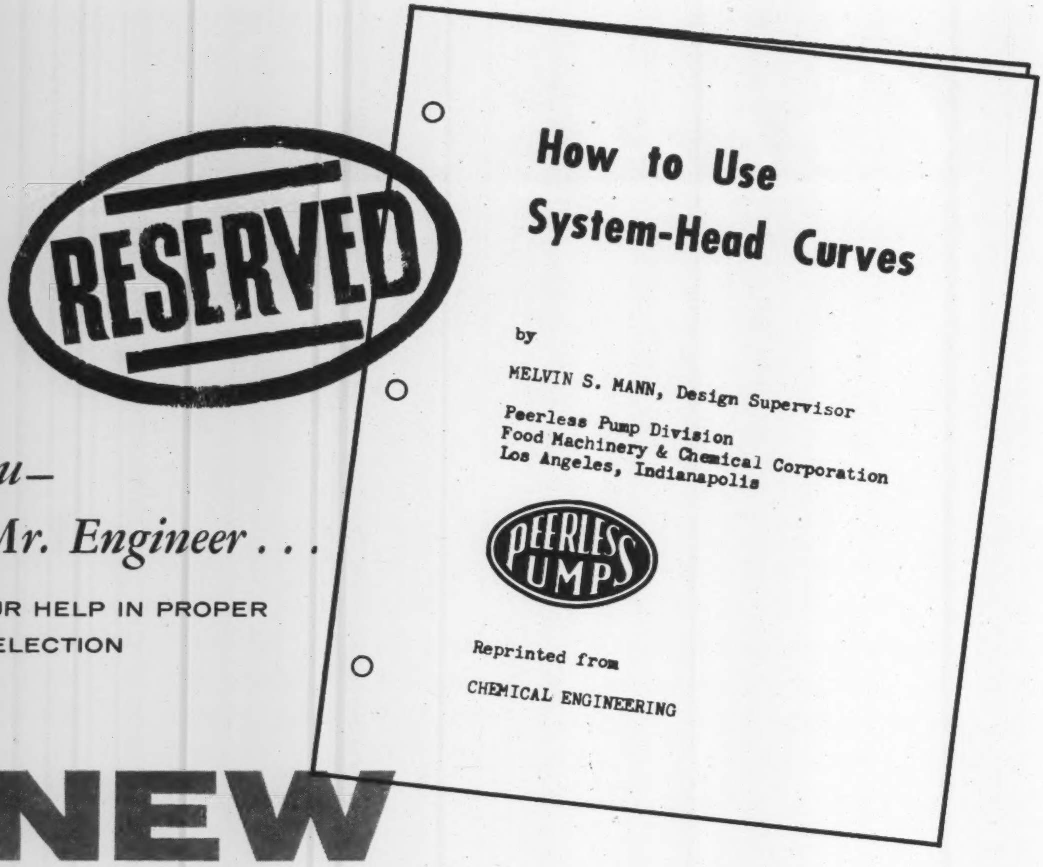
Put the advantages of CURTIS PRECISION into your next job.

Curtis
MANUFACTURING COMPANY
REFRIGERATION DIVISION

OUR 105th YEAR

WRITE DEPT. 8, ST. LOUIS 20, MISSOURI

THE CURTIS "LUXURY LINE" OF AIR CONDITIONERS COSTS NO MORE



RESERVED

How to Use System-Head Curves

by

MELVIN S. MANN, Design Supervisor
Peerless Pump Division
Food Machinery & Chemical Corporation
Los Angeles, Indianapolis

PEERLESS PUMPS

Reprinted from
CHEMICAL ENGINEERING

for you—
Mr. Engineer . . .

FOR YOUR HELP IN PROPER PUMP SELECTION

NEW

4 PAGE BULLETIN ON "HOW TO USE SYSTEM HEAD CURVES"

Yes, sir, you'll use this Bulletin every day. Printed in bold type, 8½″ x 11″ in size, with wide margins and 3-hole punched, it will bind right into a three-ring binder. In one convenient bulletin, you'll have the information you need, to avoid some of the pitfalls in pump application, by using system head curves in conjunction with pump performance curves. Data applies to industrial, engineered construction, commercial and domestic installations.

The quantity is limited, so act now. Mail the coupon below today!

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION
2005 NORTHWESTERN AVE., INDIANAPOLIS 8, INDIANA

PEERLESS PUMPS

fmc FOOD MACHINERY AND CHEMICAL CORPORATION ®

Factories: Los Angeles 31, California and Indianapolis 8, Indiana
Offices: New York; Cleveland; Atlanta; Chicago; Indianapolis; St. Louis; San Francisco; Phoenix; Fresno; Los Angeles; Plainview & Lubbock, Texas; Albuquerque.
Distributors in Principal Cities.
Consult your Telephone Directory.

☐ Please send me Bulletin "How to Use System Head Curves"

☐ Please have a Peerless sales engineer call.

NAME________________

TITLE________________ COMPANY________________

ADDRESS________________ CITY________________ STATE________________

ME

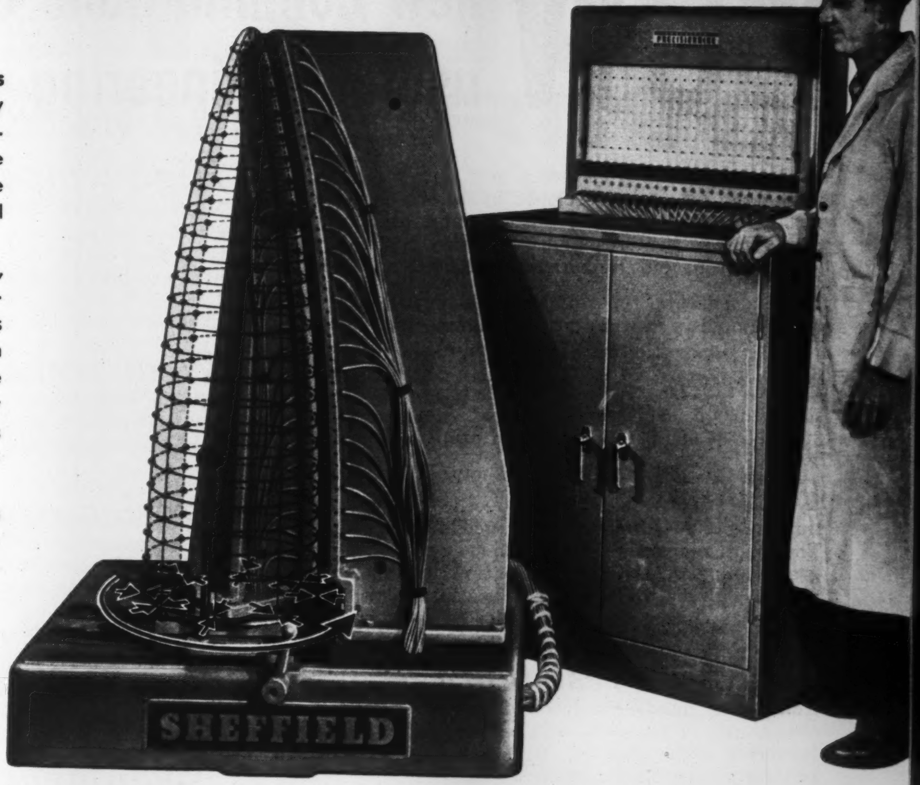
GAGES FOR MISSILE HARDWARE

Manufacture of missile hardware is admittedly exacting. A good healthy respect for dimensional precision is imperative for reliable missiles. Likewise the specialized equipment to assure the necessary high order of dimensional control.

From the outset of the missile era, Sheffield has led the gage development work in this field. Close liaison is constantly maintained with missilemen of the Armed Services. Recourse to the facilities of the Eli Whitney Metrology Laboratory and consultation with its professional staff are always immediately available.

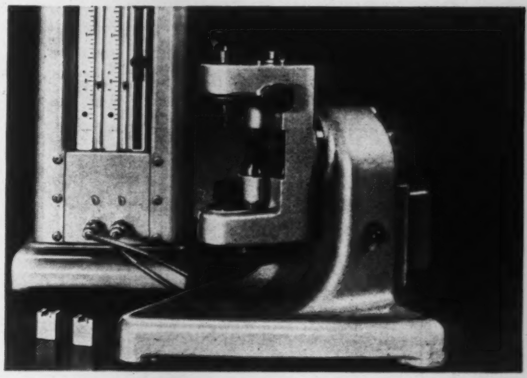
As a result, Sheffield's contributions have materially aided in the dimensional control of many missile components such as:

- **Nose cone assembly**
- **Elements of guidance systems**
- **Units of the propulsion system**



Precisionaire Gage® for accurately determining the thickness deviation of a nose cone at 128 points around its periphery from base to apex.

This assembly of Sheffield instruments automatically delivers a printed record of single or multiple dimensions. It also computes and records the difference in related dimensions.



Combination inspection gage and assembly fixture with 2-column Precisionaire instrument permits precise adjustment of end shake in gyro assemblies.

For specific information on your particular problem write to **The Sheffield Corporation, Dayton 1, Ohio, U.S.A., Dept. 41.**

the **SHEFFIELD** *corporation*
of Bendix Aviation

manufacture and measurement for mankind

Sheffield gages are used to check relationship of gimbal axes for angle and intersection of planes.

8147

NOW Ni-Resist ductile irons offer you new combinations of useful engineering properties

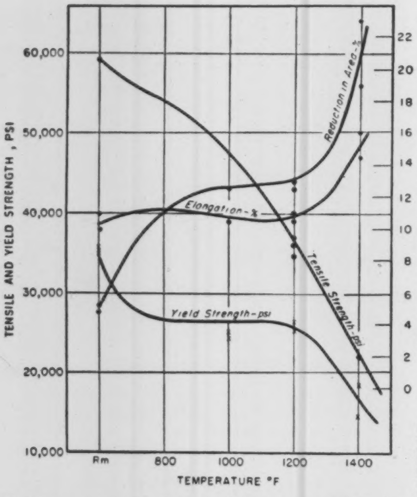
Ni-Resist* ductile irons are a new family of versatile high-alloy cast irons developed by Inco. Containing 18 to 36% Nickel, they provide the same high order of corrosion and heat resistance given by Ni-Resist flake graphite iron...plus high levels of strength and ductility.

There are several types of Ni-Resist ductile iron. Each one combines a useful array of engineering properties.

Strength Ni-Resist ductile irons provide tensile strengths of 55,000 to 80,000 psi, yield strengths of 30,000 to 44,000 psi. See graph of properties below.

Toughness Ni-Resist ductile irons give elongations of 4 to 40%, together with good impact resistance. The photomicrograph below shows why – spheroidal graphite particles allow formation of an austenitic matrix. This nickel alloy matrix develops full ductility and strength . . . keeps these properties at low temperatures.

Corrosion resistance Ni-Resist ductile irons safely handle hundreds of corrosives. Under most conditions – with acids, alkalies and salts – their performance is far superior to both cast iron and steel, helping you reduce maintenance costs.



High temperature tensile properties of Type D-2 Ni-Resist ductile iron.

Ni-Resist ductile microstructure X 100. Spheroidal graphite particles allow the metal to develop the full strength and toughness of the high alloy austenitic matrix.

High temperature properties

Ni-Resist ductile irons form a tightly adhering scale at elevated temperatures, greatly reducing further oxidation. They resist heat effects up to 1400°F and higher, have excellent thermal shock resistance. From 1100° to 1300°F, Type D-2 has stress rupture properties equal to those of cast HF stainless steel.

Wear resistance Ni-Resist ductile irons have a work hardening austenitic matrix. Graphite particles provide dry lubrication. Both properties work together to resist wear and galling over a wide temperature range.

Erosion resistance Ni-Resist ductile irons work well in wet steam, brine or salt slurries, and high velocity liquids. Their high strength and resistance to cavitation-erosion mean long service life for pump parts.

Controlled expansion Ni-Resist ductile irons have thermal expansivities from about 2.5 up to 10.4 millionths per degree F. You can match them with steels, cast irons, Nickel, Monel* alloy...with aluminum, copper, bronze and stainless steel.

Non-Magnetic properties Ni-Resist ductile irons, Types D-2 and D-2C, are non-magnetic and therefore useful where excessive heat and power losses must be avoided.

Machinability Ni-Resist ductile irons machine as well as common pressure-type gray iron, thanks to the presence of graphite in their structure.

Fluidity in casting Ni-Resist ductile irons have good flowing qualities and permit the making of intricate designs.

These are only the highlights. You can get *all* the facts on this versatile new family of metals by asking us for "Engineering Properties of Ni-Resist Ductile Irons." This 28-page booklet details engineering properties and commercial applications with numerous photos, tables, and graphs . . . gives you the information you need to decide how Ni-Resist ductile irons can help you. You'll also get "Buyers' Guide for Ni-Resist and Ni-Resist Ductile Iron Castings", listing foundries authorized to produce them.

*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street INCO New York 5, N.Y.

NI-RESIST DUCTILE IRONS

NICKEL ALLOYED IRONS PERFORM BETTER LONGER

MECHANICAL ENGINEERING

VOLUME 81 • NUMBER 3 • MARCH, 1959

Needed: More Room

Editor, J. J. JAKLITSCH, JR.

Editor Emeritus, GEORGE A. STETSON

This is a true story. At the close of its meeting on December 18, 1958, the ASME Publications Committee selected January 21, 1959, as the date for its next meeting. Naturally, all such committee meetings are held in the Engineering Societies Building in New York. A host of other ASME Committees meet in the building, such as the Executive Committee of the Council and the Board on Technology, and the administrative committees on meetings, divisions, and research. More than 100 committees under the Board on Codes and Standards, and the Boards on Honors, Membership, Public Affairs, and Education also schedule meetings. (Approximately 4000 ASME members are now giving of their experience and time, at great personal or company expense, to ASME committee work.) Result: On many occasions there is insufficient space in the present headquarters to accommodate the numerous committee gatherings that carry forward the work of ASME and the other societies.

This was the situation that faced the Editor on December 19 when he requested a meeting room for January 21—a month's notice, so to speak. ASME's meeting rooms were all booked and so were those of the other societies. How about the 20th or the 22nd? Same story!

Since all the Committee members had already arranged their schedules, and important business had to be conducted, the only recourse was to hold the meeting in some other place. This was done—but the Society had to pay for it.

While the Publications Committee or any other committee, for that matter, won't disintegrate because they can't convene at headquarters, it is a gross inconvenience to them to hold a meeting elsewhere.

For example, its members travel from Birmingham, Ala., Chicago, Pittsburgh, and as far as San Antonio, Texas. At headquarters, the files are readily accessible. Not so, if the meeting is held elsewhere. At headquarters, they can easily transact other business with the staff or other committees. Not so if the meeting place is inconvenient. At headquarters, the committee members and members in general are supposed to have a home—their home. Not so, if we can't accommodate them.

This is just one story. There are others: The Engineering Societies Library is bursting its seams; staff office space is inadequate; there is no centralized service area; there are no dining facilities.

What has happened? The present Engineering Societies Building has served as the nerve center for the engineering profession for more than 50 years. But as the technology has expanded and the societies have grown, so have their services and activities. This antiquated building is now under severe strain.

Answer: The new United Engineering Center!

To build the new Center, engineers are being asked, through the Member Gifts Campaign, to contribute $3 million. Of this, ASME's quota is $800,000. By January 30, less than 8000 ASME members had contributed a little more than $400,000. (See page 119 in this issue.)

There is still a long way to go. So fill out a pledge card, make out a check, and send both to United Engineering Trustees, Inc., 29 West 39th Street, New York 18, N. Y. If you haven't been approached or don't have a pledge card, call your Section Chairman now. Gifts to the United Engineering Center are, of course, tax deductible.—*J. J. Jaklitsch, Jr.*

A Century of Fear and

Will the starless night of barbarism descend

MODERN SCIENCE AND TECHNOLOGY rouse in us all a confused mixture of fear and hope. We are forced again and again to face the question of the destiny of the human race in a future as yet only dimly perceived but containing fantastic possibilities of good and evil.

It hardly needs saying that scientific and technical advances have often been accepted as mixed blessings. What is new in our day is the widespread fear of advance as such. A persistent and universal fear of technical science has never before dominated our thoughts and emotions to such an extent as now.

Although the answer can be found in every daily paper, it is perhaps not irrelevant to ask what is the exact cause of our fear. We are afraid that the forces we ourselves have created will one day destroy human life leaving our earth to drift on, a lifeless planet, through space. Even if our fears are exaggerated, the nightmare is huge enough to retain its paralyzing power.

It is a most disturbing fact that the techniques of peace have always lagged behind the techniques of war. The two techniques have always been in a state of phase displacement, and the time lag has today grown large enough to seal our fate in this century.

The process began more than 500 years ago with the roar of the first cannon. Nevertheless, the cannon with its cylinder-barrel, piston-projectile, explosive mixture, and spark is an internal-combustion engine. With the invention of the cannon, the technique of war thus entered its motor age 500 years in advance of the technique of peace. The voices heard then are familiar today. In 1687, a French journal addressed a plea to engineers of all countries that they should not use gunpowder in the dreadful cannon that would surely, sooner or later, blow the whole world to pieces. The gunpowder should be taken out of the cannon and put to peaceful use.

The problem is essentially the same today only more complex, more dramatic, and more dangerous.

Simple Beginnings

One day in 1919, the famous physicist Ernest Rutherford was carrying out shooting experiments in his laboratory, shooting on a miniature scale. The particles he was using as projectiles were, to say the least, of small caliber, and the nitrogen atom he was aiming at was the tiniest target ever used on any shooting range. Strangely enough he scored a hit, with the depressing result that the nitrogen atom—in spite of its much advertised indivisibility—simply broke in pieces.

So many things are broken to pieces in this world that one atom more or less would not seem to be of much significance. The end of that nitrogen atom could scarcely be feared to influence the fate of humanity.

Only 26 years later, however, in 1945, the world was shaken by another roar which proclaimed with dramatic force the beginning of a new epoch just as the roar of cannon had done in the 14th century. With the Hiroshima bomb, the technique of war entered its atomic age, once again in advance of the technique of peace.

This is no longer simply a question of great scientific interest; it is, in fact, no longer an ordinary question at all, but the handwriting on the wall:

Can we split the tiny atom without destroying the whole world?

To release the vast store of energy in the atom was not Rutherford's primary aim. His was not the kind of research program that is carried out on behalf of an industry or a special fund. Neither was he experimenting with his atoms and particles as an expert of the Ministry of Fuel and Power. Rutherford was goaded on by curiosity: Could the atom, for all its supposed indivisibility, be split?

The discoveries of science follow one upon the other because men are curious, eager for knowledge, and gifted. In the wake of the primary discoveries of science the technical advances follow more and more closely. This has the character of an almost uncontrollable automatic process. It is also an irreversible one because a valid concept is inextinguishable.

Men will seek and, in the nature of things, find; and what they find is sometimes dangerous. Sooner or later we were bound to reach the stage—we have, in fact, long since done so—when life here on earth became a matter of ever-increasing risk. At this critical stage we are bound to ask if the human race, with the vast power Techno-Science has placed in its hands, really understands how watchful it must be if the world is not to be plunged into a disaster surpassing all our nightmares.

by Edgar N. Schieldrop

University of Oslo, Oslo, Norway

Hope at the CROSS ROADS

on a wasteland?

Scientists and technicians should co-operate in demonstrating to the world at large the promise of a future made possible by modern science and technology

The Outcome

The outcome depends on self-control, unity of purpose, and ethics. A final decisive question emerges: Is the human race, with all its qualities of intelligence, spirit, and genius on the one hand and its social and ethical instincts on the other, really a species that has a chance of survival in its present environment?

Greater and greater power will accumulate in our uncertain hands. We have in truth good reason to be afraid, and yet this fantastic power that is the cause of our fear is our only source of hope.

We are fast becoming so dangerous to ourselves that we must make an ultimate choice to use our power either as a tool in a great universal co-operative effort or as a weapon in a merciless conflict after which no sun will shine on a victor but the starless night of barbarism will descend on a wasteland. That night has not yet descended. For a brief while yet we still have a tremendous opportunity.

No period of history has been more inspiring, more full of promise than ours, and none potentially as splendid. A century of fear, certainly, but also of breath-taking prospects and high adventure.

The Future

The issue in the immediate future depends on what source of inspiration will influence the many single choices and decisions that, taken together, must lead us along one of the only two roads open to us today.

Many are those who put their trust in fear. The fear of total catastrophe, they say, will keep mankind from the edge of the precipice. There is more than enough evidence to support this appeal to fear. Plans for atomic war are being assiduously prepared by thousands of experts. The whole scene is laid out in sober detail. Even so, it is too terrible to contemplate.

But is this appeal to fear enough?

Why should we rely on fear that merely holds us back from something we do not want to do? Why not nourish the hope that spurs us on to do what we wish to do? The bright prospects, the constructive possibilities should also be portrayed in the same clear detail as the horrifying alternative. We need an outline—a blueprint, as the engineer would say—of a true fantasy for every man to read:

Look what we can do with this world of ours!

A fantasy in a way—yes—but just as detailed and factual as a commercial tender. It would be the offer of technological science to the world. Before it is actually produced, none of us can fully conceive of the adventurous possibilities it would contain and yet it would be guaranteed by the most solid international concern that has ever made a tender—modern technical science. With no fear of contradiction, this concern could state with complete confidence: *We can deliver the goods.*

A Practical Proposal

Should we not then—we men of science and technology in all countries—make every effort to find the means to enable a team of the élite minds among us to prepare a blueprint that in broad but concrete terms will show all mankind what a wonderful place could be made of this planet? At this dramatic juncture we should feel that it is our duty to prevent the world from making its momentous choice blindly. There is, in fact, an obligation upon us to give to people of all nations a picture of the inspiring alternative offered by modern science and technology that can become a reality if the world is so resolved.

This is not a utopian dream but a practical proposal put forward in all modesty for making the world a better place. There is a long, long task ahead if we keep in mind not only the few privileged millions but also the hundreds of millions of the underprivileged. For no earlier generation has it been within the bounds of possibility to bring about such changes, and responsible men have never before been in a position to draw up and guarantee a practical plan for the future with such tremendous appeal. In the deepest sense, it is an appeal to moral values. The prospect before us can be a source of hope and inspire us to think and strive toward a worthy goal in the service of humanity. This ethical aspect contrasts sharply with the dark menace of the other alternative.

WRITING

Readability in scholarly papers

Technical writings continue to lack readability despite the efforts of the makers of readability formulas. Numbers of authorities have joined the assault upon opaque prose.

With variations, these formulas are concerned with elements of prose which lend themselves to "objective" analysis: Sentence length, number of syllables, familiar and unfamiliar words, personal and impersonal words found per so many words. Few will object to the obvious fact that long sentences usually are more difficult to comprehend than short sentences; no formula is needed here. And as for the remaining objective elements of writing, most should agree that these formulas are genuinely helpful in determining the readability of such things as newspaper dispatches, children's books, grade-school texts, and popular magazines. It is doubtful that these diction-readability measurements apply to papers in the technical sciences.

Writing for Engineers

In a field where such phrases as "two contiguous viscous incompressible fluids," "hydrodynamic stability," and "calibrated orifices" are commonplaces, the count-the-syllable method is out of the question. And technical writing is impersonal by nature.

Readability will not arise from the hopeful application of formulas, but rather from a thoughtful approach on the part of the writer to every aspect of the technical paper. It will result when the writer understands the psychology of the reader, realizes what the reader needs to know, and is aware of how the reader can be led through the labyrinth of the most difficult paper by exact planning and organization of material.

The suggestions offered in this article will not imply that readability need go hand in hand with simplification, in the sense of lowering the intellectual level of a paper on thermodynamics so that the man in the street can read it with understanding and interest. There is room for improvement in scholarly papers without unwarranted assaults on their intellectual qualities. We are not concerned with "popularization."

The person discussing readability in technical papers runs into two bugaboos: The shortage of space available to "unnecessary" details, and the timidity of scientific and technical writers to enter into lively and readable discussions of matters which can be stated concisely if dully. The fact is, technical writing cannot be completely impersonal, undramatic, and stylistically stultified, and be truly readable too. You don't bore your associate when you tell him about your new development; you tell it dramatically. The problem is to report the same development to 50,000 engineers through the medium of the printed page, and not bore them.

It is the proposition, here, that readable papers result largely from wise organization of material, from planning that presents the right material first.

Organizing the Main Text

How do you organize the discussion of your topic? You can, of course, sit down and write and hope for the best, risking having to jettison several weeks' or months' work because the final product is a verbal mystic maze. But this method is far inferior to the making of an outline. In making an outline, the writer has the opportunity to classify and put his thoughts into order before embarking on the actual writing, rather than ultimately being forced to work through many revisions of a hastily composed manuscript.

In outline, the writer gains quickly an adequate mental picture of what he is trying to accomplish. Faulty progressions of thought can be corrected, nonessential information discarded, supporting evidence listed in subdivisions calculated to prove the general statements advanced. Almost as important, the writer sees arising from the bare bones of his outline the paper as it would be when completed, and he has the opportunity to "revise" the paper before he writes it.

Writing and reading are opposite sides of the coin, both graphic symbolizations of mental processes for the purpose of nonoral communication. The illogically organized piece, like a rubber stamp, imprints upon the mind of the reader its illogicality. The reader who is interested enough can unscramble the imprint and, in effect, write in his own mind the paper that the writer should have written in the first place.

Subject to infinite possible variations, there are three basic organizational patterns: The logical, the chronological, and the psychological.

---

[1] Assistant Professor, Department of English, affiliated staff member of Division of Engineering Sciences, Purdue University, Lafayette, Ind.

Condensed from an article by Professor Fielden entitled, "Writing Readability Into Technical Papers."

PAPERS FOR READABILITY

By John S. Fielden[1]

in the technical sciences cannot result from the arbitrary application of magical formulas. It must arise from intelligent planning and organization of the material and from an understanding of the psychological process of reading.

Consider Reader Psychology

The psychological method will not follow any ordinary pattern of logic. The "logic" will be entirely on the part of the writer; the unsophisticated reader will be unaware of it. The writer determines the order of presentation by considerations concerning the effect of each point upon his intended readers.

Suppose a proposal requesting immediate approval for a research project is to be written. The most important point might be the need for a considerable amount of financial backing; yet to make this request the first remark in the proposal might not be wise psychologically. The importance of the proposed research, the benefits which might accrue to the company or institution—such matters as these should be developed prior to the mentioning of such highly important but psychologically negative matters as expenses and man-hours away from other projects.

Even in purely scientific publication, it should not be held that there is no place for the psychological organization of material, especially when one's aim is (even if ever so discreetly) the obtaining of readers for one's work. The more popular the publication, the more obvious the need for a psychological[2] organization of material. But even in the purely scholarly article, there is nothing wrong in beginning one's main text with the material of greatest interest to the reader. Why should it be considered more scholarly to move from the less interesting to the more interesting than to move from the highly interesting to the less, buried somewhere in the center of the paper?

First Things First?

The chronological pattern needs little explanation. Using a time relationship, the writer reports that first this was done, then that. Chronological organizations are commonly found in sections of papers which give instructions as to how to operate machines or processes. In such cases, this pattern is satisfactory; in others it is not, because it does not allow the writer to distinguish nicely between the importance of items reported. The old saying, "first things first," may not hold. The first event in time is not necessarily the first event in importance.

Yet to the inexperienced writer, a chronological organization comes first to mind. After all, didn't he gather the material chronologically? Ask a person what he has done this day and he will answer, "Well, first I got up feeling rather tired, but after I had breakfast . . . ," and so on. It will take a genuine effort of his intellect to organize his answer in categories more meaningful to his listener. Just as in the case of the reader of a chronologically organized paper, his listener will have to sort through the chaff of inconsequentials to find the answer he seeks.

With the exceptions noted above, and perhaps some few others, the chronologically organized paper is less readable and requires more effort on the part of the reader than does the paper which has been designed for an over-all logic of presentation.

Organization by Logic

Far more generally readable are papers organized logically, according to a deductive organizational pattern which leads the reader's mind from general to specific, or from given premises to their necessary conclusions. The experienced writer realizes that material is most readily assimilated when the general proposition is placed first and then supported by specific detail. The key to much clear and readable writing is the maxim that one should never keep secret from the reader the direction in which one's development of a topic is heading.

One other logical pattern, the inductive, finds utility when one must describe a system or machine which is generally too complex for immediate comprehension. In this case, it might be wise to begin by discussing parts of the system rather than its totality, gradually building up section by section in the reader's mind. Use of a simple analogy might help.

Once the organizational pattern is established, it should be reflected in the headings and subheadings which increase the readability of the paper. Such headings serve as road signs, forcing the writer to keep his paper sharply organized and not wander like a drunken driver through traffic-laden streets, coming up sharp at dead ends, crashing to complete stops against unforeseen obstacles.

---

[2] Editor's note: The psychological method usually appears only in the work of the skilled writer; yet it is the method you invariably and instinctively use in telling an associate about your work.

By H. L. Peek, Engineer-in-Charge,
New Product Development Group, Boston Works,
Allis-Chalmers Manufacturing Company, Boston, Mass.

TRIP-FREE MECHANISMS

The function of a trip-free mechanism is simply to disengage the driven parts of a machine from the driver or prime mover in response to an external impulse. Trip-free mechanisms are most widely applied to and are absolutely necessary for the proper functioning of a modern power circuit breaker.

Circuit breakers must perform a dual function. They normally serve as a switch to close and open electrical circuits carrying load currents in response to the manipulation of an operating handle or button located either at the breaker or remotely. Their second and more important function, however, is to operate automatically as a safety device to open the electrical circuit in response to overcurrents or faults.

Circuit-breaker contacts are closed by actuation from the operator or prime mover through a linkage system. The operating power may be manual solenoid, electric motor, or it may be stored energy in the form of pneumatic-pressure, pneumohydraulic pressure, or closing springs.

Most circuit breakers are opened by springs where energy has been stored by the closing prime mover during the closing stroke. The opening energy is held captive by a latching device until released by a tripping impulse from operating personnel or from a fault-responsive relay or overcurrent trip device. Especially designed interrupting devices assist in speedy extinction of the power arc that results when the circuit-breaker contacts are parted. In modern high-voltage oil circuit breakers, the allowable time from trip impulse to circuit interruption is as low as three cycles (0.05 sec).

The tripping impulse normally comes after the circuit breaker has been closed for some time. In such cases, the closing prime mover is de-energized immediately after closing, and in the best designs resets to the open position. Under such normal conditions, with the prime mover already de-energized, a trip-free mechanism is not necessary.

Why "Trip-Free" Is Necessary

A trip-free mechanism is required on a circuit breaker to provide for the *abnormal* condition where the breaker is closed to energize a circuit that has become faulted. It then serves to disengage the breaker from its closing prime mover, permitting the breaker to open at its prescribed opening speed even though the closing prime mover is still energized.

In order to grasp the full importance of trip-free mechanisms to the modern circuit breaker, it is necessary to understand two more requirements of present-day electrical systems, namely, continuity of service and system stability.

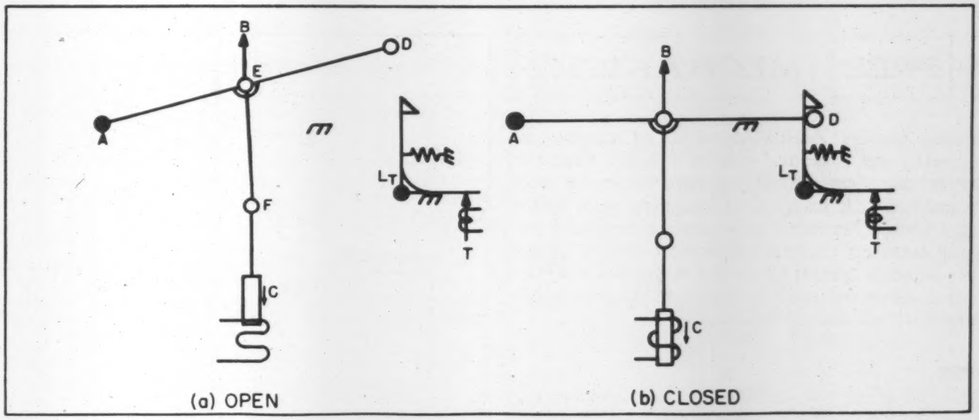
These factors have led to the practice of operating breakers through a reclosing cycle, closing a breaker instantaneously or with a preset time delay after an interruption and, if the fault is still present, repeating this cycle several times before the breaker stays open or "locks out." The fault must then be repaired before service can be restored. Generally, it has been found that 85 per cent of the faults on a system are transient in nature, such as are caused by lightning discharges, and if interrupted for approximately $^{1}/_{5}$ of a second will be permanently cleared. One half of the remaining 15 per cent will be cleared if interrupted a second time.

To prevent a transient fault from resulting in an outage, the modern high-voltage circuit breaker may be required to reclose its contacts in less than $^{1}/_{3}$ of a second (20 cycles) after receiving the initial trip impulse. If the fault is not cleared by the first opening, the circuit breaker may be required to again open and reclose at the same speed. Still a third opening and reclosure within 20 cycles may be required before the breaker is automatically locked open.

This requirement for fast reclosing greatly increases the possibility of the breaker being closed against an already grounded or faulted line. The purpose of the trip-free mechanism is to completely and instantaneously disengage the breaker contacts from the prime mover to insure the same fast response to a tripping impulse in such abnormal operations as those inherent in normal operations. In other words, a properly designed trip-free mechanism always permits the breaker to open swiftly and freely in response to a tripping impulse

---

Condensed from a paper contributed by the Machine Design Division and presented at the Semi-Annual Meeting, Detroit, Mich., June 15–19, 1958, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.



(a) OPEN (b) CLOSED

Fig. 1 Nontrip-Free Mechanism

Closing Operation: The prime mover, represented symbolically by a solenoid, moves in direction **C**, when energized, closing breaker connected at **B** through link **EF** by rotating closing lever **AD** clockwise until trip latch L_T grasps roller at **D** to hold it in closed position.

Tripping Operation: When tripping means **T** is energized, trip latch L_T is rotated counterclockwise permitting breaker to open in direction **B** under action of breaker opening springs.

Evaluation: This mechanism is not adequate for modern requirements because it does not provide for a release of the breaker from the prime mover.

without waiting for the magnetizing flux of a closing solenoid, the kinetic energy stored in a rotating closing motor, or the closing pressure behind the driving piston of a compressed-air or hydraulic mechanism to be dissipated.

Kinds of Trip-Free

Published standards define several kinds of trip-free action; any one, or several of which may be provided by a given mechanism:

A *Trip-Free.* A breaker-operating mechanism is trip-free when the opening operation prevails over the closing operation.

B *Trip-Free in any Position.* A breaker-operating mechanism is trip-free in any position when the opening operation prevails over the closing operation at any position of the contacts.

C *Electrically Trip-Free.* A breaker-operating mechanism is electrically trip-free when the opening operation prevails over the closing operation even though the closing control circuit is energized.

D *Mechanically Trip-Free.* A breaker is mechanically trip-free when the tripping mechanism can trip it even though: (a) In a manually operated breaker the operating lever is held in the closed position, or (b) in a power-operated breaker the operating mechanism is held in the closing position either by power or by means of an emergency closing lever.

E *Pneumatically Trip-Free.* A breaker-operating mechanism is pneumatically trip-free when the opening operation prevails over the closing operation as a result of the release of closing air from the closing cylinder.

F *Hydraulically Trip-Free.* A breaker-operating mechanism is hydraulically trip-free when the opening operation prevails over the closing operation as a result of the release of the closing liquid from the closing cylinder.

In addition, the term *selectively trip-free* may be applied to a circuit breaker which is nontrip-free on normal opening, but mechanically trip-free when opened immediately after closing.

Electrically trip-free action, obtained simply by proper arrangement of electrical controls, will therefore not be discussed further in this paper.

Illustrations of Trip-Free Mechanisms

A careful study of Figs. 1–9 will provide a good understanding of how trip-free action has been and can be accomplished in circuit-breaker mechanisms. In most cases the linkages are represented by single-line diagrams with fixed points represented symbolically by solid dots, fixed parts of frame by cross-hatching, and so forth, and the mechanisms are stripped of all but the bare essentials necessary to convey the trip-free concept. Actual operating mechanisms are oftentimes so cluttered with a multiplicity of auxiliary devices, and operator frame and linkage take on such a complex shape to adapt themselves to these auxiliary devices, that identification of the method of trip-free operation is lost.

Comparative Rating of Trip-Free Mechanisms

If comparative values are assigned to the various characteristics with the greater number of points for the better efficiency, the comparison of types is as follows:

Fig. no.	Simplicity	Stability	Closing efficiency	Resetability	Ease of manufacture	Opening speed	Composite rating
2	2	3	2	2	3	2	14
3	4	2	2	2	4	2	16
4	1	2	2	2	3	2	12
5	2	3	3	4	1	3	16
6	2	3	3	2	2	4	16
7	4	3	4	4	4	4	23
8	4	2	2	4	4	4	20

The nontrip-free mechanism of Fig. 1 is left completely out of the rating as being wholly inadequate. Fig. 9 is not included since it employs the same type mechanism as Fig. 7.

TRIP-FREE MECHANISMS

The various factors evaluated vary, of course, in importance with the type and size of breaker that the mechanism is used on. Small circuit breakers may have such small shock forces that stability is of lesser importance. Other breakers may not be required for fast reclosing service; therefore fast reset-ability is not important. In such special cases the importance of the characteristics measured may be weighed against other requirements such as limited space.

Bibliography

1 L. J. Linde and H. L. Peek, "Developing a Superspeed Trip-Free Reclosing Circuit-Breaker Mechanism," *Trans. AIEE*, vol. 71, part 3, August, 1952, pp. 734–742.

2 Carl Thumin, "Trip-Free Mechanisms for Operation of Circuit Breakers," *Power Plant Engineering*, December, 1939.

3 H. L. Peek and M. Dyer, "Introduction of Hydraulic Operation to Low-Voltage Air Circuit Breakers," *Trans. AIEE*, vol. 75, part 3, April, 1956, pp. 226–232.

4 E. R. Perry and H. W. Morelli, "A New Hydraulic Mechanism for Power Circuit Breakers," AIEE Technical Paper No. 54-31, November, 1953.

5 H. L. Peek, "A New Universal Mechanically Trip-Free Four-Bar-Linkage Mechanism for Intermediate-Voltage Power Circuit Breakers," AIEE Conference Paper No. 56-701, June, 1956.

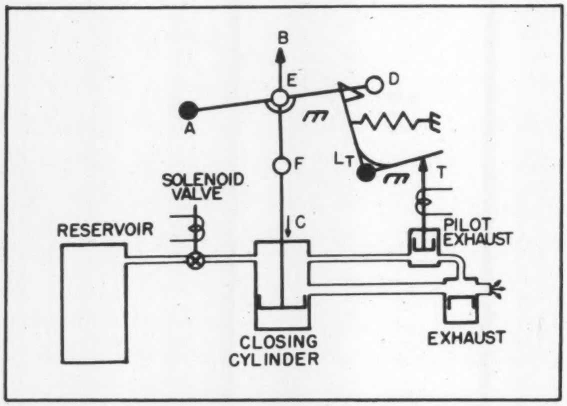
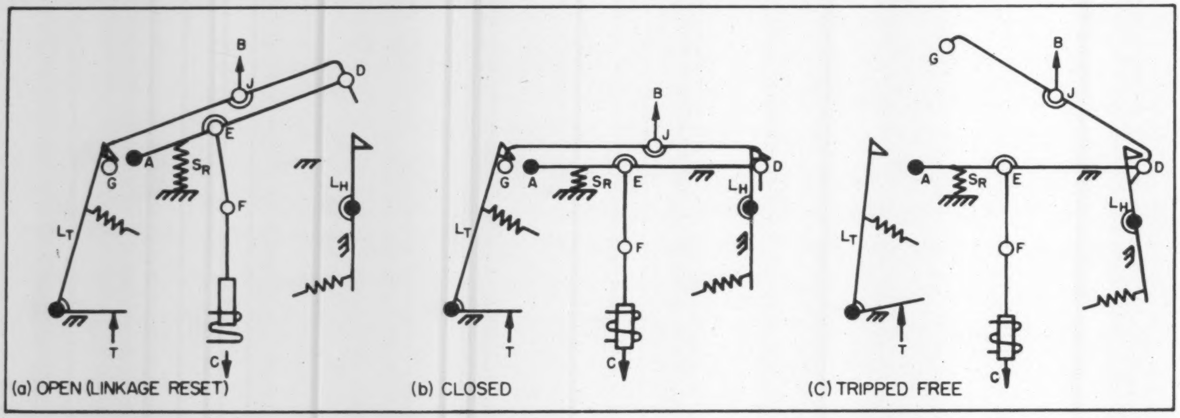


Fig. 2 Pneumatic Trip-Free Mechanism

The non-trip-free linkage of Fig. 1 is used, but the opening operation is made to prevail over the closing operation by arranging for the trip coil to release the closing air.

Tripping Operation: Movement of trip armature trips latch while simultaneously opening pilot exhaust valve and opening contacts in solenoid valve coil circuit, not shown.

Evaluation: This mechanism is less reliable than mechanically trip-free types because of possibility of sticking valves. Also, the time required to operate valves and to exhaust closing air reduces the opening speed.



(a) OPEN (LINKAGE RESET)

(b) CLOSED

(C) TRIPPED FREE

Fig. 3 Two-Bar Mechanically Trip-Free Linkage

A second lever, trip-free lever **GD**, has been added to the nontrip-free mechanism of Fig. 1. The latch of Fig. 1 has become merely a holding latch L_H, while the tripping impulse is applied to a second latch L_T. Actually, **A** and **G** are on the same axis but are separated in the diagram for clarity.

Closing Operation: Same as Fig. 1 with levers **GD** and **AD** moving as one.

Tripping Operation: Tripping impulse is given to trip latch L_T. Breaker connected at **B** opens under action of its opening springs regardless of state of energization of the prime mover **C**. In opening, trip-free lever **GD** rotates clockwise, pivoting about pin **D** which hinges it to the closing lever **AD**, until it reaches tripped-free position shown at (C).

Resetting Operation: A lug on the end of trip-free lever at **D** releases holding latch L_H at end of trip-free opening stroke. After the force of the prime mover **C** is removed, retrieving spring S_R forces closing lever **AD** to rotate counterclockwise back to position (a). During this operation, trip-free lever rotates counterclockwise about pin **J** which connects it to breaker pull-rod **B**, at the end of the resetting stroke, roll **G** moves latch L_T counterclockwise to slip under its latch face in readiness for another closing stroke. A latch check switch, not shown, is customarily employed to prevent energization of the closing circuit before latch is in place over roll **G**.

Evaluation: Although this mechanism has excellent trip-free action, it is sluggish in resetting because the heavy solenoid (or closing piston if prime mover employs air or hydraulic pressure) must be accelerated by the retrieving springs; it is therefore inadequate to meet the present-day fast reclosing requirement. Tension-type latches also tend to be heavy and sluggish, thus lengthening the mechanical tripping time.

Fig. 4 Two-Bar Selectively Trip-Free Linkage

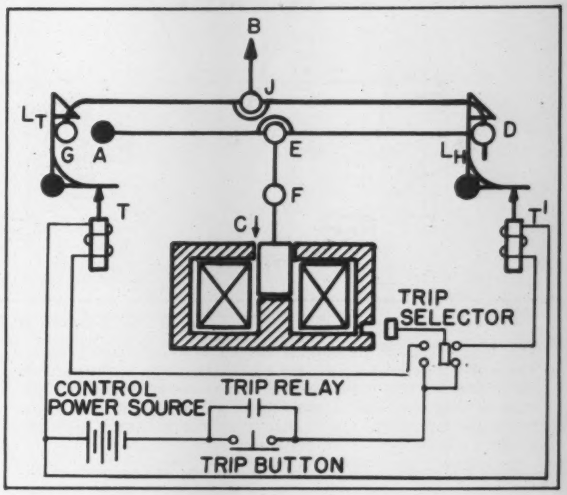
Linkage is identical to that in Fig. 3 except arrangement has been made to deliver the tripping impulse to either the tripping latch or the holding latch.

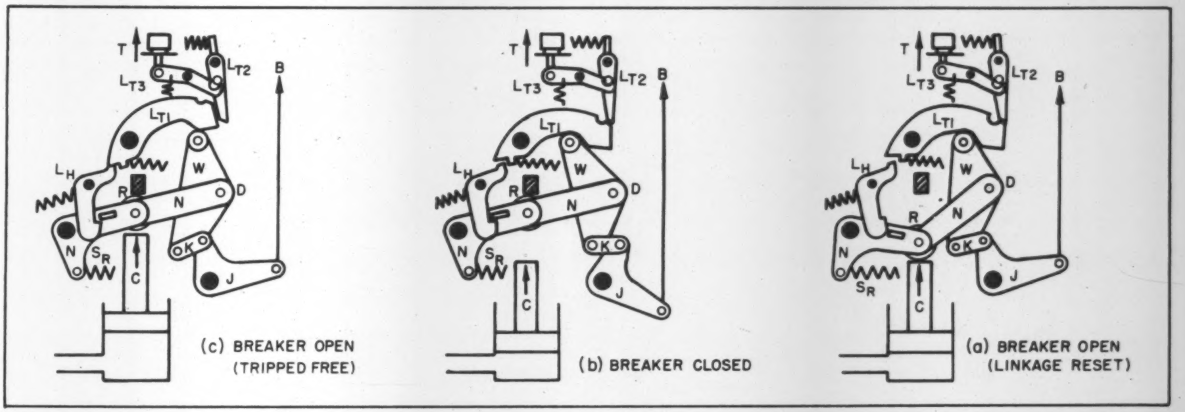
Normal Tripping Operation: (Closing prime mover de-energized). The tripping impulse is given at **T′** releasing $\mathbf{L_H}$. The mechanism acts like the nontrip-free mechanism of Fig. 1. Closing lever **AD** and trip-free lever **GD** move together from position of Fig. 3 (b) to position of Fig. 3 (a).

Trip-Free Operation: (Closing prime mover energized). The magnetic trip selector under action of the flux of closing solenoid (or pressure from a pneumatic or pneumohydraulic prime mover) transfers the trip impulse from **T′** to **T**. The mechanism opens trip-free as described in Fig. 3 (c).

Evaluation: When smooth functioning of trip-selector and both tripping means are attained, this is an improvement over the mechanism of Fig. 3 in that one fast reclosing operation can be attained. This is possible because on the first opening operation the breaker is never disengaged from the prime mover; therefore the prime mover can be re-energized as soon as breaker is tripped before breaker reaches full open position.

Disadvantages: (1) Addition of trip selector introduces new possibilities for trouble; (2) second and subsequent reclosures are slower than the fastest required of present-day breakers; (3) first opening is retarded because breaker must drag along the heavy solenoid or piston of the prime mover.





(c) BREAKER OPEN (TRIPPED FREE)

(b) BREAKER CLOSED

(a) BREAKER OPEN (LINKAGE RESET)

Fig. 5 Toggle-Operated Trip-Free Walking Beam

This arrangement, for a number of years, was the only fully mechanically trip-free mechanism in commercial use that could reset quickly enough to obtain high-speed reclosing. Commercial mechanisms contemporary with it resorted to pneumatic trip-free action to obtain fast reclosing performance, sacrificing considerable tripping speed and reliability.

Closing Operation: Closing ram **C** moves toggle roll **R** from position (a) to position (b). Toggle links **N** in straightening out provide increasing thrust to walking beam **W** at **D**, rotating it counterclockwise about its upper end which is held fixed by 3 stages of latching $\mathbf{L_{T1}}$, $\mathbf{L_{T2}}$, $\mathbf{L_{T3}}$ which reduce the force required of the trip coil. The lower end of walking beam closes the breaker through link **K** and crank **J**. Holding latch $\mathbf{L_H}$ maintains closed position.

Trip-Free Operation: A small trip force **T** causes the three latch stages $\mathbf{L_{T1}}$, $\mathbf{L_{T2}}$, $\mathbf{L_{T3}}$ to collapse, releasing upper end of walking beam. Breaker opening springs acting in direction **B** open breaker by rotating walking beam **W** clockwise about **D**.

Resetting Operation: $\mathbf{L_{T1}}$ when released kicks off $\mathbf{L_H}$ at same time as it releases walking beam. If closing ram is in position shown in (b), the relatively light toggle links **N** are reset shortly after breaker contacts part by retrieving spring $\mathbf{S_R}$. This permits re-energizing the prime mover and reversing the breaker as soon as interruption is accomplished, long before breaker reaches full position. If closing ram is in position shown in (C), the breaker still opens at highest speed and linkage resets after pressure behind closing piston is exhausted.

Evaluation: This linkage is one of the more effective. Its retrieving action because of the low inertia of toggle links and walking beam is very rapid, permitting very fast reclosing times. There are, however, several disadvantages: (1) Because of the walking beam lever ratio, the load that must be held by the primary latch $\mathbf{L_{T1}}$ is even greater than the breaker load; (2) hook or tension-type latches are employed. These inherently possess greater mass inertia than prop-type latches when designed to handle the same loads. The mechanical latch release time is, therefore, longer than that required with prop-type latches; (3) the upper end of the walking beam must be guided by channels to move along a fixed path. The machining of these channels is difficult and expensive.

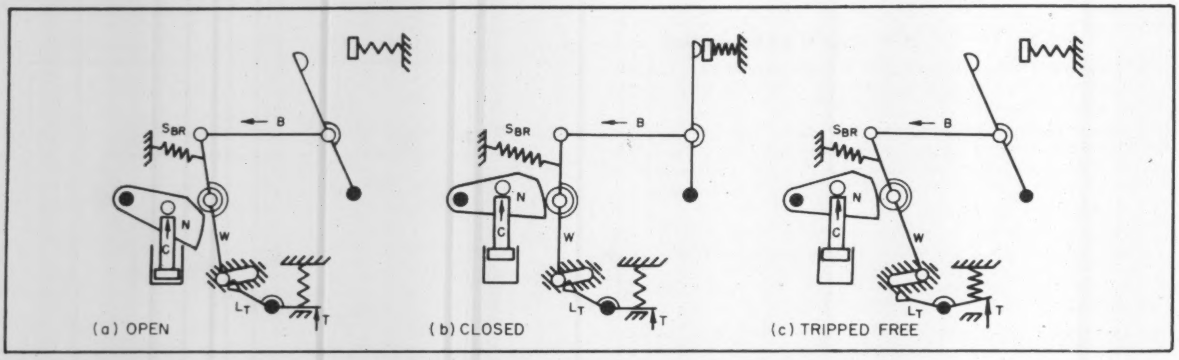


Fig. 6 Cam-Operated Trip-Free Walking Beam

This type linkage is currently employed in small circuit breakers. The action is very similar to that described in Fig. 5. The essential differences are that the increasing mechanical advantage to match breaker characteristics is provided by a cam instead of a toggle; the retrieving spring S_{BR} also is so disposed as to act as a breaker accelerating (opening) spring.

Closing Operation: Closing force **C** forces cam **N** counterclockwise, which in turn rotates walking beam **W** clockwise about its lower end closing breaker contacts against spring S_{BR} and breaker contact springs acting in direction **B**. When closed position (b) is reached, a holding latch, not shown, acts on cam **N** to maintain closed position.

Trip-Free Operation: Tripping force **T** rotates trip latch L_T counterclockwise, releasing lower end of walking beam and permitting breaker to open in direction **B** by forcing walking beam counterclockwise about its center roll.

Resetting Operation: The counterclockwise rotation of walking beam releases the holding latch, not shown, on cam **N**, permitting it to return to position shown in (a). Spring S_{BR} then rotates walking beam **W** clockwise about its upper end to retrieve it to position (a).

Evaluation: Prop-type latches, used here, are preferable to tension-type latches used in mechanism of Fig. 5. It is difficult to design a cam to match breaker characteristics, especially where prime-mover travel is small. This difficulty in cam design comes about because of the necessity of using a follower roll instead of a point follower. Other manufacturing difficulties arise because of requirement to guide lower end of walking beam.

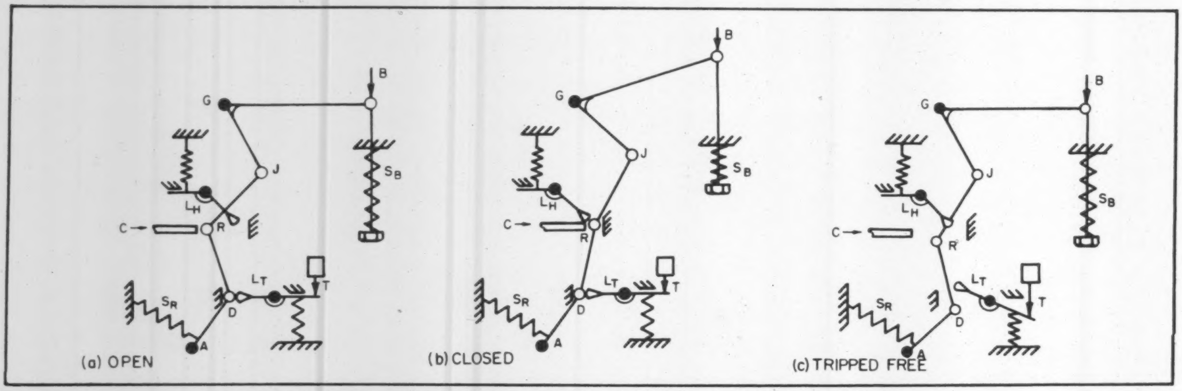


Fig. 7 Four-Bar Toggle-Prop-Type Mechanically Trip-Free Linkage

Closing Operation: Trip latch L_T holds trip toggle roll **D** stationary while closing ram **C** moves main toggle roll **R** from open position (a) to closed position (b). Holding prop L_H maintains the closed position. During this operation, the main toggle, in straightening out, provides the increasing mechanical advantage necessary to match increasing load from the breaker provided by breaker accelerating spring S_B, breaker contact springs, not shown, and electromagnetic forces that result when closing against an already grounded line. Closing ram resets when prime mover is de-energized.

Trip-Free Operation: Tripping force **T** rotates trip latch L_T clockwise, as shown, by tripped free position (c), permitting breaker opening springs, acting in direction **B**, to drive breaker open regardless of position of closing ram.

Resetting Operation: During tripping, main toggle roll **R** moves downward, generally following trip toggle roll **D**, but as soon as it clears holding prop L_H the closing toggle collapses and begins to reset under combined action of the breaker opening springs S_B and linkage reset springs S_R.

Evaluation: This type of mechanism is the simplest, quickest acting, and most reliable of all the mechanically trip-free mechanisms yet devised. Simple compression-type links have low mass inertia and require no special guide channels. Prop-type latches are shortest and lightest (no bending stresses) and are thus quick acting. The unfolded trip toggle provides sufficient force to unlatch the breaker if the tripping impulse is received at the beginning of the closing stroke when the breaker reaction is small, and reduces the trip latch load by straightening out as breaker approaches closed position. This permits a small, fast trip magnet to be employed. The closing toggle provides increasing mechanical advantage during closing to match the increasing breaker load. Resetting is so fast that the linkage is reset and ready for a reclosure soon after breaker contacts part on normal opening and is dependent only on the speed with which the closing prime mover can be de-energized and reset on subsequent reclosures. Combination of this type mechanism with a pneumo-hydraulic prime mover is in Fig. 9. Both these prime movers are designed to exhaust their closing pressure and reset the closing ram sufficiently fast to get shorter than 15-cycle reclosures repeatedly.

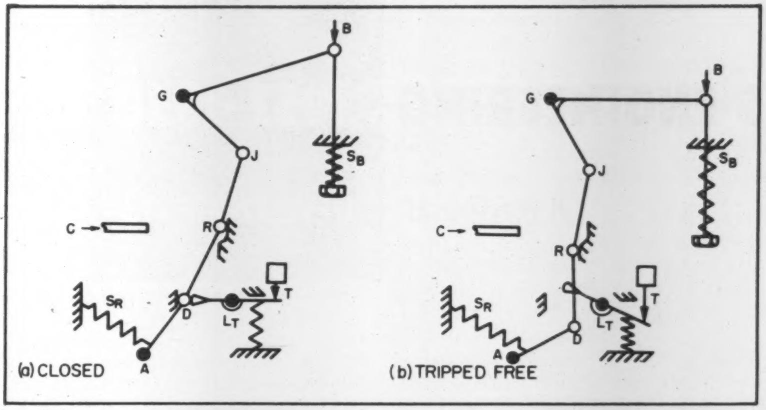

B
G
J
S_B
C
R
S_R
D
T
L_T
A
(a) CLOSED
B
G
J
S_B
C
R
S_R
D
T
L_T
A
(b) TRIPPED FREE

Fig. 8 Four-Bar Toggle-Overcenter-Type Mechanically Trip-Free Linkage

This is a variation of the linkage of Fig. 7 which eliminates the holding prop by arranging to have the breaker maintained in the closed position by having the main toggle lock in the overcenter position as shown at (a). When tripped free, the overtravel stop, by reason of its shape, breaks the toggle to cause the linkage to reset. See position (b).

Evaluation: The same as Fig. 7; however, it should be pointed out that the portion of the prime mover stroke which is employed in forcing the toggle to the overcenter position is lost as far as useful work is concerned. Therefore, if the prime mover is a solenoid, the most powerful portion of the stroke, that portion with the shortest air gap is lost. If this type is used with a compressed air or hydraulic stored energy mechanism, fewer operations can be obtained on a given size of storage tank.

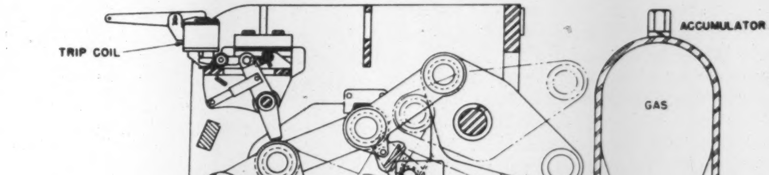

TRIP COIL
ACCUMULATOR
GAS
CONTROL RELAY
RESERVOIR
RAM
OIL
CONTROL VALVE
SOLENOID
PRESSURE BLEED VALVE
CHECK VALVE
CHECK VALVE
STRAINER
PRESSURE RELIEF VALVE
HAND PUMP
BY-PASS VALVE
MOTOR
POWER PUMP
FILTER

Fig. 9 Four-Bar Toggle-Prop-Type Linkage Combined With Quick Resetting Pneudraulic Prime Mover

Operation: Control valve, when energized, admits pressure from accumulator under piston thus closing breaker. Spool of valve while connecting lower chamber to accumulator also connects upper chamber of cylinder to reservoir. As piston reaches closed position, pressure admitted to control relay de-energizes control valve. Reversal of valve spool reconnects lower chamber of cylinder to reservoir and upper chamber to accumulator. Pressure on top of piston drives the ram rapidly back to the reset position at the bottom of the stroke. Successive reclosing operations even shorter than those obtained with a pneumatic prime mover are possible.

PLASTICS ENGINEERING 1957-1958

A Review of DEVELOPMENTS

By R. I. Leininger
and R. A. Clark
Battelle Memorial Institute,
Columbus, Ohio

PLASTICS are gaining a foothold in new areas while becoming more firmly established in their best-known fields of application [1].[1] End-item uses are opening up in the automotive, aircraft, building, missiles, and agriculture fields. Significantly, these are potentially large-volume markets and add to the importance of plastics as materials of construction. The largest use of plastics, of course, continues to be toys, housewares, appliances, wire coatings and extrusions, packaging and films, and flooring. There has been increased interest and emphasis on the use of plastics in construction. These uses include structural applications such as the glass-reinforced polyester panels forming the roof of the U. S. pavilion at the Brussels World's Fair. The use of adhesives and sealants in building was summarized at a conference held by the Building Research Institute last December [2].

The stimulus of adding new plastic materials of construction to those previously known, and the impressive expansion of plant facilities for a number of plastics, notably polyethylene, have intensified the competition between individual types for present markets. The selection of the best plastic for a given application is becoming more difficult, in view of the increasing number of types available, but lines of demarcation are beginning to appear. Examples of the misuse of plastics are diminishing, due principally to the accumulation of more information concerning the performance characteristics of plastic materials. Thus it is now possible to utilize plastics for engineering applications with more confidence. Improvements in the design of plastic items and advances in methods for formulating and shaping them also have been instrumental in upgrading the quality of plastic goods. Production of plastic materials was up to about 4.3 billion lb from 3.9 billion lb in 1956 [1]. Polyethylene and glass-reinforced plastics had the largest increases.

MATERIALS

Polyethylene. The number of types of polyethylene is increasing so that an almost complete spectrum from low density (high pressure) through medium density to high density (low pressure) is available. Each type is made with a particular set of properties optimized for certain applications. While most emphasis, publicitywise, has been on the low-pressure, high-density linear types, the medium-density materials have made the largest gains. As would be expected, this type bridges the gap in properties between the two extremes. Production capacity of the linear types was 300 million lb per yr by the end of 1957 [3]. Total capacity for all types was about 850 million lb per yr.

An important advance has been the development of new antioxidants [4] which provide up to five times the oxidation stability. The importance rests in the extension of the useful life of the newer polyethylenes at higher temperatures so that their intrinsically higher strength may be better used.

High-pressure polyethylene has been modified to meet the challenge of the higher tensile types; high heat resistance and toughness have been achieved by cross-linking a carbon-black filled polymer with peroxide [5]. In this method, the polyethylene is "vulcanized" by heat after extrusion or molding. In another method not yet commercial in the United States, polyethylene is treated with ozone which enables high and reinforcing loadings of black to be used [6].

Polypropylene. Polypropylene, perhaps the forerunner of a series of polyolefins to come, is now available from two producers (Hercules in this country, and Montecatini in Italy). Capacity of the Hercules plant is reported to be 20 million lb per yr. Interest is high in the use of polypropylene in molding, extrusions, film, and filament because of its high heat resistance and high strength. It will no doubt also compete with nonpolyethylene plastics such as high-impact styrene and nylon. Montecatini has produced an elastomeric polypropylene [7].

Polystyrene. The search continues for higher heat and higher impact resistance for this workhorse among the thermoplastics. Polymethylstyrene, after a long induction period, is now available with higher heat resistance [8]. A new high-temperature, high-tensile styrene copolymer appears to extend the usefulness of copolymer pipe into hot-water systems [9].

Interest is high toward making stereospecific polystyrene with very high heat-distortion temperatures. An indication of this is a recent Australian patent application which has recently been published [10] dealing with a catalyst for such a polymer. The search continues for a clear, high-impact polystyrene, but none is yet available commercially. The older variety of polystyrene is still appearing in new forms. For example, a biaxially oriented film has been announced by Dow. This is primarily a packaging material with high clarity. It will doubtless compete with cellulose acetate and cellophane.

Acrylates. There have been several notable developments in the past year in the field of acrylic plastics. A new, high-impact material [11] has become available.

---

[1] Numbers in brackets designate References at end of paper.

Contributed by the Rubber and Plastics Division and presented at the Annual Meeting, New York, N. Y., November 30–December 5, 1958, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

It is in the same price range as standard acrylics and will compete propertywise with cellulose-acetate butyrate and impact styrenes. Methods have been developed for casting monomer-polymer slurries in low-cost aluminum molds to produce items such as egg-crate light diffusers [12]. Methacrylate syrups have also been developed to replace styrene in polyesters to give better weatherability [13].

Dow Corning has announced a methacrylate-modified silicone (Syl-Kem 21). This monomer polymerizes readily in bulk, emulsion, or suspension to produce a clear, tough plastic. It is notable for its very low coefficient of friction against steel surfaces. A binder-free paper from acrylic fibers has been developed for electrical uses and filtration.

Ureas and Phenolics. Improvements continue for these materials in making them more suitable for continuous automatic machinery and larger items [1]. New, high-temperature asbestos-reinforced phenolics have been announced by two producers [14, 15], and others will no doubt be soon forthcoming. One of these is suitable for continuous use at 500 F and for intermittent use at 900 F. Even at 2500 to 3500 F, it would preserve an appreciable percentage of its strength for 10 to 15 sec. Reichhold has a phenolic resin for very high temperatures.

Polyesters. A polyester thermoplastic film, Videne, has become available [16] which has good aging and abrasion resistance and can be laminated to wood, metal, plastic, and paper without special adhesives. It will supplement already available Mylar film to which it is related. The modification of thermosetting polyesters through the use of methylmethacrylate has already been mentioned.

Fluorocarbons. Du Pont has announced a new specialty rubber, Viton A. A similar product, known as Fluorocarbon Elastomer 214, has been produced by Minnesota Mining and Manufacturing Company. Both are copolymers of vinylidene fluoride and hexafluoropropylene. They show outstanding heat resistance at 400 F and resist oxygen, ozone, organic solvents, and mineral acids and alkalies. Their probable primary uses will be in O-rings, packings, hose, and wire jackets. It is probable that they will compete with other specialty rubbers such as silicones and tetrafluorethylene.

Du Pont has also announced a Teflon 100-X, a modification of Teflon. It has a low melt index, permitting extrusion in conventional machinery.

Advances have also been made in fluorinated polyethers [17], polyesters [18], and alkyl silanes [19].

Polyethylene Oxide. Late last year Carbide announced a new class of water-soluble resins [20]. The resins have many properties of polyethylene, but differ in water solubility and melting point (65 C). The resins are water-soluble and produce very viscous solutions. Solid resin, however, is so crystalline that it is not affected by relative humidity up to 90 per cent. Possible uses are films, fibers, thickeners, and adhesives.

Polycarbonates. These new resins [21, 22, 23] have potential applications where very high impact resistance and very high heat and oxidation stability are needed. They have very good dimensional stability and will withstand 570 F for 24 hr in inert atmospheres. Coil forms, gears, and lenses are possibilities.

Polyformaldehyde. This is another very high melting, highly crystalline thermoplastic [21, 24], possessing a heat-distortion temperature of 212 F at 264 psi and 340 F at 66 psi. It will compete with nylon in applications such as bearings, gears, and bushings.

Polyurethanes. Early in 1957, it appeared that polyethers would replace polyesters for many types of polyurethane foams. More recently, polyesters based on dimer acid [25] appear to have certain advantages over both the conventional polyesters and polyethers in foam production. Lighter foams can be made from the dimer polyesters with excellent hydrolytic-stability and load-deflection properties. The picture is not clear in the case of semirigid foams.

General Tire and Rubber has announced a new polyurethane rubber, Genthane "S," which has very good oil and ozone resistance and is also resistant to ultraviolet. It can be processed on standard rubber machinery to have good high-temperature stability and superior abrasion resistance.

Use of Radiation. Radiation continues to occupy the interest of major plastic producers. However, no commercial use has been announced this year. The formation of graft copolymers by irradiation continues in the laboratories, but no products have been commercialized. The one example of radiation processing, crosslinking of polyethylene by irradiation, has met serious competition from the new high-strength linear polyethylenes. American Machine and Foundry is contemplating production of a radiation-grafted ion-permeable copolymer for use in brackish-water purification.

NEW PRODUCTS

Plastic Films and Containers. This largest single market for plastics is destined for considerable future growth, despite its amazing $15-billion size today. Its current public favor is evidenced by the phenomenal demand for plastic garment bags and for plastic packages for food, both fresh and frozen [26]. Consumption for packaging is thought to reach 300 million lb per yr by 1960, double that in 1957. Advances in polyethylene film were quickened by the availability of production quantities of high-density (HD) polyethylene [27]. Due to its greater strength compared to that of conventional low-density (LD) polyethylene, it can be employed in thinner film gages than previously utilized for packaging material. Announcements have been made that two of the producers of HD polyethylene now have transparent grades that offer considerable promise in the packaging field. Extensive outdoor uses for film are developing, as is evident in the growing utilization of plastics by the building industry as a moisture barrier and by the farming industry as a mulch for growing crops. Cast-polyethylene film with greater clarity and gloss is now available, as is biaxially oriented polypropylene film.

The producers of cellophane claim their position is not in jeopardy despite competition from polyethylene, especially cast sheet, and the looming of polypropylene on the horizon [28]. Perhaps a part of this confidence stems from the wedding of cellophane with polyethylene and other film formers in the form of laminates. The futures of polyvinyl chloride and Saran are still optimistic [1, 29], though now slightly behind polyethylene in sales. The production capacity for film in general is running ahead of the market, but not too far ahead of the predicted requirements for the near future.

Extra thick (10-mil) polyethylene sheet is about ready to challenge other materials for the shipping of bulk materials [30]. Inroads already have been made for plastics for this application by their use as liners for the fabrication of conventional paper bags, drums, and barrels. Plastic liners, coatings, and laminates are becoming more widely used in packaging than ever.

***Plastic Pipe* [31].** Thermoplastic pipe continues to show healthy growth, with polyethylene accounting for at least 75 per cent of the business. The balance of the market is shared mostly by cellulose-acetate butyrate, Saran, styrene-rubber blends, and rigid polyvinyl chloride. Efforts have been made to utilize polymethylacrylate, nylon, chlorinated polyethers, and polyfluorinated plastics for pipe, but their usage is limited to special applications.

Both HD and LD polyethylene have found application in pipe, the former being preferred for chemical installations, while the latter is finding wide usage for the transportation of potable water. The reinforcement of polyethylene with filler materials such as carbon black offers to extend its usefulness into new areas.

More has been learned about the engineering limitations for using plastic pipe. Time-temperature-pressure situations have been studied in an effort to supply the engineering data needed to predict performance of pipe in service. The tendency of thermoplastics to creep under temperature-pressure loads is being offset in some installations by extruding plastic pipe inside metal pipe, or otherwise reinforcing its exterior.

Advancements in the utilization of thermosetting plastics, such as phenolics, polyesters, furans, and epoxy resins, have been slow and account for only about five per cent of the total plastic-pipe market. While such materials are capable of withstanding higher temperatures and pressures, and are preferred for many installations, their cost of fabrication is a major factor in deterring their large-volume production.

Reinforced Plastics. Materials in this category are making a significant impact on the automotive industry, now reaching the 140-million-lb mark for this single application. Items fabricated for this purpose include automotive bodies and structural parts, accessories for heater and air conditioners, transmission parts, and other miscellaneous applications [32]. About 28 million lb of reinforced plastic were used for nonautomotive purposes, such as for plastic boats which have matured in engineering design this past year [33]. About 22 million lb were used last year to make about 50,000 boats [34]. This latter market is expanding more slowly than anticipated, but its growth appears healthy and is of particular interest to plastic manufacturers because it is a relatively new outlet. Polyester resins comprise the bulk of resin employed in reinforced plastics, but epoxy resins, phenolics, polystyrenes, silicones, melamines, and vinyls are increasing in importance. Studies of the resin and reinforcing agent are leading to better composite structures [35, 36].

Improved epoxy-type resins, reinforced with high loadings of metal powder or metal fibers, are now being used to make even large-size tools and dies, and at a fraction of the cost required for similar products made entirely from metal [12, 37, 38]. These can be made in much less time and produce ideal tooling for forming metal in medium-sized production runs, such as 130,000.

Progress has been made in the development of new resins that possess better resistance to weathering, fire, high temperatures, and chemicals. Problems associated with high-speed aircraft, atomic power, and missiles have spurred considerable activity in this direction. Announcements were made that a diallylphthalate resin has been produced with a heat-distortion point above 390 F and a phenolic-silane resin functional to about 500 F [39]. High flexural-strength values at 500 F [40] also were reported for reinforced laminates based on phenolic and epoxy resins, and with a silicone resin at 900 F [41]. Evidence is mounting that the difficult task of safely returning a missile from outer space, which generates frictional heats in the order of 10,000 F in going through the earth's atmosphere, may be accomplished with plastics rather than with metals. This astonishing development is attributed to the lower thermal conductivity of plastics [1, 21].

A unique method was developed for reinforcing plastic film with Dacron or nylon yarn. Applicable to all the thermoplastic films to increase their tensile strength and tear resistance, the fabrication technique consists of cementing parallel fibers of reinforcing yarn to sheets of plastic and then cementing two of these together in such a way that the fibers cross each other at right angles [42].

Foamed Plastics. Production of foamed plastics has been accelerated by the development of new uses and the expansion of those existing already. The construction industry takes nearly 15 per cent of the plastic industry's total output today, and some have predicted that this application could rise nearly 500 per cent in the next several years [43]. Among the foams used in building are the polyurethanes, phenolics, and polystyrene.

The automobile industry is one of the largest markets for flexible foams [44]. Competing for this prize are rubber, polyurethane, and polyvinyl-chloride foams. Improvements in the cushioning properties of polyurethane foams by the use of polyethers [45] and dimer acids [46] improve their position in this contest.

Polyurethane foams in garment linings have become commercially accepted, due to their excellent insulation and "breathing" qualities and to their ability to withstand dry cleaning. Unicellular vinyl sponge has also been used in wearing apparel such as jacket linings, footwear insulation, shoulder pads, and other applications where inertness to perspiration, greater warmth, and comfort are desired [47]. Open-cell vinyl foam, both chemically and mechanically blown, is used in wearing apparel in such applications as shoulder pads and helmet linings. It appears to find greater volume use in cushioning, particularly in public transportation where its fire resistance and similarity to the softness and resilience of foam rubber are virtues.

The familiar polystyrene foam, long available in the form of logs, blocks, and sheets of various sizes, has been augmented by the introduction of expandable pellets. These pellets can be expanded with heat to fill intricately shaped voids and to mold to curves.

Adhesives. Research continues to develop adhesives for both high temperature applications and for the difficultly bonded materials. For example, a partially hydrogenated butadiene [48] has been found to give a strong bond between polyethylene and brass or rubber. A modified silicone [48] has been developed for bonding silicones. The bond between butyl rubber and tire cord has also been improved [49].

Eastman has developed a fast-setting, high-strength adhesive which gives practically instantaneous bonding for materials which would otherwise be difficult to bond. The speed of bonding varies from a few seconds to a few minutes. Glass-to-glass bonds are complete within 5 to 15 sec; steel-to-steel bonds develop 2000-psi tensile strength within 30 min. Solvent resistance is good, but temperatures above 212 F or high humidity and high temperature destroy the bond.

Miscellaneous. Outstanding resistance to heat, impact, and water absorption are claimed for Lexan [22, 23], a new polycarbonate resin, and to a lesser degree for Delrin [24], a polyformaldehyde resin. Both offer considerable promise as engineering materials. For example, Lexan is so tough it has been used to make plastic nails, which have the advantage over metal nails that they do not damage saw blades. These thermoplastics may find usage as bearings, gears, hinges, valves, and other mechanical items.

ENGINEERING

Engineering Properties. Notable developments have been made this past year in the engineering side of the plastics industry [50]. The determination of engineering properties of plastics is continuing to receive much attention. More and more information is becoming available on the behavior and lifetime of plastics under service conditions. Less dependence is being placed on the results of time testing as criteria for engineering design. This problem was discussed by A. G. H. Dietz in an introductory chapter in the recent compilation of "Technical Data on Plastics [51]."

Suggestions were made as to a program for performance testing of molded articles [52]. The properties and performances of plastics in the chemical-processing industry were discussed [53]. Fatigue properties of glass-reinforced plastics were determined under various conditions [54, 55]. An ingenious spiral test mold has been devised to measure the moldability of polyethylene [56]. The SPI is continuing its project at Battelle Memorial Institute on the determination of the long-term properties of thermoplastic pipe.

Processing and Equipment. Advances have been made in processing along the lines of more continuous and more highly automated equipment. For example, automatic preheaters have been coupled to automatic presses in the molding of phenolics [57]. Continuous-vacuum-forming presses were reviewed in a recent article [58]. Progress has been made in continuous-vacuum-forming lines starting with the extrusion of the sheet and ending with a trimmed, finished article.

A new development in injection molding has been patented by the Columbus Plastic Products and licensed to Grace Chemical [59]. It controls flow during the molding process and allows precompression of the molding compound, thus reducing cycle time and increasing plasticizing efficiency.

Dry coloring of thermoplastics can be improved by means of a newly designed breaker plant [60]. Rotational molding is supplementing slush molding for vinyl plastisols [61]. Objects as large as hobbyhorses have been molded by this method.

Methods of formulating and molding polyester promise higher volume production at lower costs. [62]. The use of diamond-coated tools to saw and machine glass-reinforced plastics was discussed [63].

Factors influencing a choice of a particular injection-molding machine were evaluated [64]. Comparative data on injection-molding machines were summarized [65]. Induction heating of extruder barrels has been introduced by National Rubber Machinery Company. In this, heat originates within the walls of the cylinder rather than outside, such as resistance windings.

Some idea of the size of the thermoplastic forming industry is seen by the number of machines sold during 1957. Injection molding, extruders, and sheet thermoforming machines totaled 1043, 812, and 430, respectively [66]. The last category is notable because the number of sheet thermoformers has grown from 500 in 1954 to 1632 in 1957.

REFERENCES

1 *Modern Plastics*, vol. 35, January, 1958, p. 83.
2 "Adhesives and Sealants in Building," Publication 577, Building Research Institute.
3 *Chemical Week*, January 18, 1958, p. 80.
4 Hawkins, et al., 132nd Meeting ACS.
5 *Chemical Week*, August 31, 1957, p. 36.
6 *Chemical Week*, May 17, 1958, p. 60.
7 *Chemical Week*, December 7, 1957, p. 87.
8 *Chemical Week*, October 27, 1957, p. 119.
9 Naugatuck Chemical Division, U. S. Rubber Company.
10 Australian patent application 29, 198, 1957.
11 *Chemical and Engineering News*, June 17, 1957, p. 84.
12 *Modern Plastics*, vol. 34, June, 1957, p. 269.
13 *Modern Plastics*, vol. 35, March, 1958, p. 137.
14 *Chemical and Engineering News*, February 3, 1958, p. 58.
15 *Plastics Technology*, vol. 3, May, 1957, p. 476.
16 *Chemical Week*, February 22, 1958, p. 71.
17 *Industrial and Engineering Chemistry*, vol. 49, August, 1957, p. 1241.
18 *J. Polymer Science*, vol. 24, March, 1957, p. 33.
19 *J. Chemical Society*, 1957, p. 1038.
20 *Chemical and Engineering News*, November 4, 1957, p. 21.
21 *Modern Plastics*, vol. 35, January, 1958, p. 153.
22 *General Electric Review*, November, 1957, p. 14.
23 *Chemical and Engineering News*, February 17, 1958, p. 64.
24 *SPE Journal*, vol. 14, March, 1958, p. 25.
25 *Chemical and Engineering News*, November 11, 1957, p. 60.
26 *Chemical and Engineering News*, February 17, 1958, p. 82.
27 *Materials in Design Engineering*, vol. 48, July, 1958, p. 98.
28 *Chemical Week*, February 1, 1958, p. 75.
29 *Chemical Week*, February 16, 1957, p. 71.
30 *Chemical Week*, May 10, 1958, p. 65.
31 *Plastics Technology*, vol. 4, January, 1958, p. 46.
32 *Chemical Week*, November 9, 1957, p. 82.
33 *Plastics Technology*, vol. 3, November, 1957, p. 904; vol. 3, December, 1957, p. 992.
34 *Chemical Week*, December 14, 1957, p. 85.
35 *SPE Journal*, vol. 13, November, 1957, p. 33.
36 *SPE Journal*, vol. 13, December, 1957, p. 25.
37 *Chemical and Engineering News*, February 17, 1958, p. 70.
38 *Plastics Technology*, vol. 4, March, 1958, p. 232.
39 *Chemical and Engineering News*, February 17, 1958, p. 60.
40 *SPE Journal*, May, 1958, p. 39.
41 *SPE Journal*, vol. 13, August, 1957, p. 42.
42 *SPE Journal*, vol. 13, September, 1957, p. 27.
43 *Chemical and Engineering News*, June 16, 1958, p. 26.
44 *Plastics Technology*, vol. 4, February, 1958, p. 151.
45 Detroit Meeting of SPE, January, 1958.
46 *Modern Plastics*, vol. 35, May, 1958, p. 145.
47 *SPE Journal*, vol. 13, July, 1957, p. 42.
48 *Chemical Week*, September 28, 1957, p. 65.
49 A. L. Miller and S. B. Robison, 132nd Meeting ACS.
50 *Modern Plastics*, vol. 35, January, 1958, p. 117.
51 Manufacturing Chemists Association, 1957.
52 *Plastics Technology*, vol. 3, August, 1957, p. 640.
53 *Corrosion*, vol. 13, 1957, p. 74.
54 *Modern Plastics*, vol. 34, June, 1957, p. 34.
55 *Plastics Technology*, vol. 3, September, 1957, p. 721.
56 *Plastics Technology*, vol. 3, October, 1957, p. 809.
57 *Plastics Technology*, vol. 4, April, 1958, p. 353.
58 *Plastics Technology*, vol. 4, April, 1958, p. 335.
59 *Plastics Technology*, vol. 4, February, 1958, p. 152.
60 *Plastics Technology*, vol. 4, May, 1958, p. 447.
61 *Modern Plastics*, September, 1956, p. 159.
62 *Plastics Technology*, vol. 3, October, 1957, p. 805.
63 *Plastics Technology*, vol. 3, June, 1957, p. 467.
64 *Plastics Technology*, vol. 4, May, 1958, p. 439.
65 *Plastics Technology*, vol. 4, May, 1958, p. 442.
66 *Modern Plastics*, vol. 35, January, 1958, p. 143.

Although generally known only for their heat resistance, specialized refractories possess excellent thermal conductivity, abrasion resistance, hot strength, thermal-shock properties, impact resistance, and chemical inertness. While they have certain limitations, with some precautions and proper maintenance they will give extended service at considerable reduction in cost for many applications.

A New Look at... Specialized

By Roy W. Brown, Manager, Technical Services, Refractories Division,

Types of inorganic nonmetallics—better known as specialized or super refractories—are frequently catalogued as being able to resist heat only, yet they possess excellent thermal conductivity, abrasion resistance, hot strength, thermal-shock properties, impact resistance, and chemical inertness.

They do not possess precise properties in the sense that a specific alloy is precise. They do not offer a panacea because drawbacks sometimes go hand in hand with their useful properties. Acceptance of these negative factors, however, leads to a clearer understanding of the positive product qualities; diverse applications; range, complexity, and limitations of shape design; and subordination of heat resistance to other characteristics.

Why Specialized Refractories Differ

Silicone carbide, aluminum oxide, and mullite—unlike natural-earth-mineral refractories such as fire clay, silica, and chrome—are crystal products of the electric furnace with special attention given to grading or sizing, mixing, forming, and firing. The bond, whether ceramic or chemical, constitutes only a small part of the product. Properties of the electric-furnace crystalline materials are retained to the maximum degree. This helps explain their resistance to corrosion, load, wear, heat shock, and high temperatures.

Variations to grit sizing, bonding, and even forming methods, enhance specific qualities of a product and make it more useful under a given set of operating conditions. In this way, a family is created.

One family of ceramic-bonded silicon carbide consists of over 50 standard varieties. Another family consists of raw materials melted in an electric furnace which are molded and annealed the same as metal castings.

Recently, silicon carbide has been bonded with silicon nitride, providing a range of product characteristics and formability much broader than that of ceramic-bonded silicon carbide.

The potentialities of these materials should excite the imagination and stimulate the ingenuity for which the engineering profession is noted.

Greater Wear Resistance

Frequently, the abrasion resistance of these nonmetallics is overlooked even though the crystalline materials from which they are made are often formed into metal cutting and polishing abrasives, and wear problems exist at all temperatures from subzero to over 3000 F.

A coke chute, for example, Fig. 1, lined with fused-cast refractory showed no appreciable wear after 13 months despite handling 2800 tons of coal daily. Silicon carbide that replaced metal alloys in teeth for rabbles used in a multihearth furnace extended service life 15 times and at lower initial cost. A suction cover made from nitride-bonded silicon carbide to exceptionally close tolerances and installed in a slurry pump showed no wear after 10 months' service.

The results of Zeiss impingement tests on some of these nonmetallics are shown in Fig. 2. Fused aluminum-oxide grain, with Mohs 9.0 hardness, easily cuts holes in and polishes most of the metals considered conventional for abrasion resistance.

There are two basic types of abrasion: (*a*) Impingement by fine solids suspended in either air, gas, or liquid; (*b*) direct abrasion by a mass of dry or wet solids flowing across or at the surface. Degree of wear depends upon such variables as size, hardness, shape, weight, and concentration of the abrasive particles. Velocity and direction of impact, temperature, and possible corrosiveness of the abrading material are also factors.

Most high-velocity impingement erodes the containing materials, but bonded silicon carbide, and some varieties of bonded-alumina refractories, are most resistant to this condition. A ceramic-bonded silicon-carbide lining in a flue connecting gas generator and carburetor showed no erosion after 10,000 hr despite continuous attack by abrasive particles entrained in hot gases traveling at high speeds. The same kind of lining in a cyclone dust collector on a sinter machine typically reveals no wear after 3-yr service. Under the same conditions, hard-fired brick intended to resist wear averaged less than 4 months' life.

Impact of heavy objects falling upon a surface can cause progressive bond fracture of ceramic-bonded materials. Without a bonding or holding medium,

---

Contributed by the Maintenance and Plant Engineering Division and presented at the Annual Meeting, New York, N. Y., November 30–December 5, 1958, of The American Society of Mechanical Engineers. Condensed from Paper No. 58—A-187.

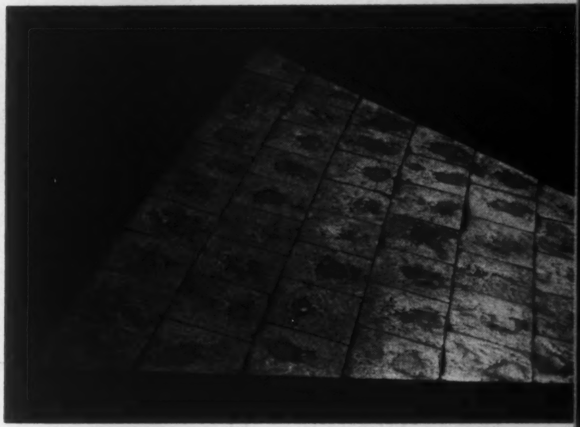


Fig. 1 Handling 2800 tons daily, this coke chute is lined with 3-in. thick fused-cast blocks. After 13 months' service the "wrinkles," typical of a newly cast shape, are still evident. The target area shows no wear from impact of falling coke.

Refractories

The Carborundum Company, Perth Amboy, N. J.

refractory grains are removed mechanically. For this type of abrasion, fused-cast refractories are a logical choice. They rely upon interlocking crystals rather than upon bonded crystals.

Broad Values of Thermal Conductivity

Over the years, nonmetallics have acquired the distinction of being good insulators. Metals, on the other hand, have demonstrated thoroughly their ability to conduct heat.

In actuality, the nonmetallics being discussed provide a far greater range of thermal conductivity—from insulation to conduction—than any other class of material, as in Fig. 3.

While cast iron and alloy steels are exceptional heat conductors, this ability decreases as temperatures rise. Moreover, use limit is approximately 1500 F. Ceramic-bonded silicon carbide, usable to about 3000 F, has a conductivity that is virtually a straight-line curve from 105 Btu/hr, sq ft, and 0 F/in. of thickness at 1000 F, to 112 Btu at 2900 F. A rough measure is about 11 times that of fire clay and 70 per cent that of the chrome-nickel steels.

A highly conductive silicon-carbide boiler-tube facing decreases the possibility of reaction between slag accumulations and the facing and gives maximum heat flow. Any slag that might adhere can be barred off with ease.

One of the more important uses of bonded silicon carbide's high thermal conductivity is in muffled structures. It reduces the thermal gradient to such an extent that work-chamber temperatures can be maintained, even at maximum production rates, without endangering combustion-chamber refractories from the heat head. Some vitreous-enameling furnaces, for instance, operate at rates that soon would destroy substructures by overheating should a less conductive muffle material be used.

A diametrically opposite use of this property is to *dissipate* heat rapidly. Without this ability, silicon-nitride-bonded silicon-carbide rocket-nozzle throats would be totally unable to withstand the searing heat developed in uncooled motors.

Where thermal conductivity of silicon carbide is a disadvantage, insulation will retard heat flow sufficiently to permit use of this material because of its other desirable properties.

At the other end of the scale is a refractory composed of alumina "bubbles" or hollow spheres bonded together. Aluminum-oxide melt from an electric furnace is poured into an air or gas stream yielding material which has good insulating properties to above 3100 F, where other insulations are inadequate. Formed into shapes or employed as a castable, it can be used as a backing lining, or even a main lining, such as in air heaters or synthesis gas generators.

A newer product, with a comparatively low K factor, is a 50 per cent alumina, 50 per cent silica fiber that is used successfully at temperatures from 1500 F to above 2300 F. It is available in several forms including bulk, blanket, rope, tape, roving, yarn, wicking, cloth, and wire-inserted cloth.

Joint packing in regular masonry brickwork with bulk fiber and rope keeps furnace dirt, brick spalls, and similar material out of joints. With its resiliency and refractoriness, structural expansion takes place as planned and averts maintenance problems that might occur.

More Materials to Fight Corrosion

Maximum life of 18 hr from cast-iron, wire-aluminizing sinker rolls has led to substitution of nitride-bonded silicon-carbide rolls which give highly satisfactory 3 to 6-week service. They do not dissolve and contaminate the molten aluminum; they resist the abrasive action of the rapidly moving wire, and show no dimensional changes at the end of the run.

Specialized refractories, as a general class, are far more resistant to the types of corrosion usually found at high temperatures where molten slags, metals and fluxes, and corrosive fumes are encountered than are the refractories made from nature's raw materials. This greater resistance is imparted largely by the extraordinary temperatures at which the crystals are formed, lessening any tendency to change shape or go through a conversion phase at lower temperatures.

Applying to both classes of materials are those general conditions that are most important in considering chemical problems—acids react with bases, and vice versa, and their reaction rates usually increase with temperature. Silicon carbide is acid in nature, whereas the aluminas, both bonded and fused-cast, and the mullites, tend to be between acid and neutral.

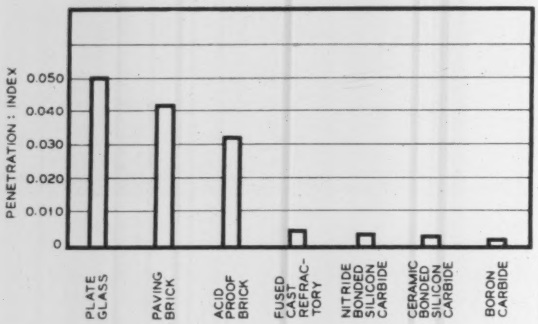


Fig. 2 Comparative abrasion resistance of different nonmetallics after being blasted with aluminum oxide grain (Mohs hardness 9.0) for the same period in a Zeiss impingement test

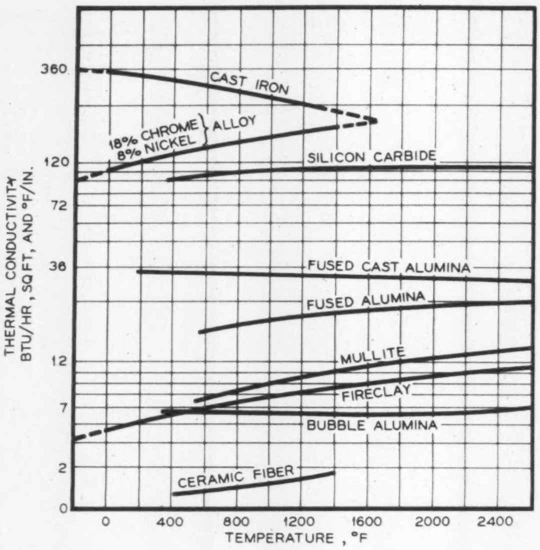


Fig. 3 Thermal conductivities of different refractories and metals over a wide temperature range. Noteworthy are the comparative curves for heat-resistant metals and silicon-carbide nonmetallics which conduct heat above metal temperatures.

Fireclay refractories, although having some degree of inherent chemical stability, are often incapable of providing other necessary attributes such as abrasion resistance, thermal-shock resistance, or thermal conductivity.

In handling a corrosion problem, material-supplier's experience can be of assistance, and consulting laboratories are available for studies of new and potentially serious corrosion difficulties. The thermal microscope permits actual reactions simulating service conditions up to 4000 F to be observed or to be recorded on film.

Thermodynamic studies also can be applied to the reactivity of aggregates and bonds with various gases, slags, metals, and similar materials.

Carry Loads Under Heat

Alloy roller tubes lack sufficient hot strength to carry $^{3}/_{8}$-in. stainless-steel sheet through annealing furnaces fired to 2450 F with silicon-carbide radiant tubes. Silicon-carbide rollers, on substitution, stayed straight and minimized roller-caused scratches and other defects in the sheet.

Hot strength is a more important property for high-temperature maintenance work than refractoriness, which is only a measure of ability to stand up at temperatures. Hot strength measures the degree of volume stability at temperatures—in other words, retention of volume under load. Load comes from an external weight, such as a furnace charge; from a superimposed load, such as a furnace side wall; or even from stresses within a structure itself, such as when thermal expansion takes place.

Hot strength varies whether metals, common refractories, or specialized refractories are involved.

Many nonmetallics give satisfactory service in well-defined ranges of temperature and load, but become increasingly susceptible to deformation and ultimate failure above their range. Deformation of some refractories under various loads and temperatures after 100-hr tests are shown in Table 1. These data indicate over-all hot strength of a material and how the latter might perform under extended and short-duration loads.

Installing ceramic-bonded silicon-carbide skid rails in the hearths of forge-shop furnaces for the handling of 2250 F steel slugs at the rate of 250 pieces an hour, boosted average life between major repairs to 9 months, eliminating almost constant repairs and extending a life of less than 3 months.

The strength necessary to sustain loads also contributes to the ruggedness of specialized refractories under impact. In the coke-chute lining previously cited, coke hits the chute liner with considerable impact, creating a problem comparable to that of wear. Essential impact resistance is provided by the interlocking crystalline structure of these materials that makes them far stronger than amorphous natural-refractory bodies.

Resist Temperature Changes

Heat shock is often part of a process requirement, a brazing-fixture cycle, a quench in a chemical reaction, a heat-treating operation, or the instantaneous heat release in a guided missile or packaged steam generator.

Business tempo calls for rapid cycles from cold to hot to cold without expensive shutdowns. Precautionary measures to minimize temperature fluctuations in many furnaces are uneconomical. Thermal-shock resistance, therefore, becomes a property of importance.

Silicone-carbide fixtures were substituted in a production brazing operation for alloy supports which warped after 5 trips through an atmosphere furnace working on a 1-hr cycle from cold to 2100 F to cold, where increasing

Table 1 Comparative Data on Sustained and Short-Duration, High-Temperature Load Tests

Refractory compositions	100-hr 25-psi load test		$1\frac{1}{2}$-hr 25-psi load test	
	Hold temperature, deg F	Linear cold contraction, per cent	Hold temperature, deg F	Linear cold contraction, per cent
Silicon-nitride-bonded silicon carbide	2732	0.0	2732	0.0
Ceramic-bonded silicon carbide			2732	Nil
	2732	0.58	3146	0.78
Electric-furnace mullite	2732	1.23	2732	0.11
			3128	1.31
Bonded fused alumina	2462	0.25		
	2732	8.68	3130	8.86
Fused-cast beta alumina	2732	0.0	2732	Nil
Converted kyanite	—	—	3137	14.3
Chrome magnesia	—	—	Crushed at 3002	Sheared
Magnesia	—	—	Crushed at 2552	Sheared
Silica	2732	0.13	Crushed sharply at 2948	Sheared
High alumina	2462	7.7	Squashed at 3011	25.46
Fire clay	2462	11.3	Squashed at 3002	25.0
Fire clay	2462	15.1	Squashed at 2993	26.6

support thickness had made them so heavy that they absorbed most of the furnace heat. These less costly fixtures doubled service life and eliminated sticking of brazing metal to the support.

Similarly, nitride-bonded silicon-carbide fixtures employed for continuous brazing of turbine blades for jet engines consistently gave 100 to 150 trips without reworking where high-temperature-alloy supports had to be replaced after 25 trips. Initial cost of metal fixtures was about 20 times that for the refractory.

More recent products to oppose heat shock are lithium-alumino-silicate compositions. Among their properties, they offer practically zero expansivity used as holding and brazing jigs, resistor cores, and other parts subjected to severe thermal shock at moderate temperatures. They also can be machined readily.

Regardless of broad applications, certain fundamentals affect thermal-shock resistance. Magnitude of shock, furnace design, refractory shape, and operating conditions can be varied to improve performance. Major influence stems from thermal conductivity, tensile strength, modulus of elasticity, and thermal expansion. Low thermal expansivity, obviously, is desirable since it prevents a nonuniform or differential expansion across a cooled and uncooled portion of a structure. High thermal conductivity minimizes differences in the thermal gradients. Hot strength is essential to meet the inevitable strains that develop.

Combined Properties of Value

It is evident that qualities other than temperature resistance make specialized refractories potentially advantageous. Selection of a material based on a key property can lead to trouble. While bonded silicon carbide has outstanding thermal conductivity, there are some ranges where it is susceptible to a slow rate of oxidation that, unchecked, might cause ultimate failure. Fortunately, several positive steps can be taken to retard oxidation of silicon-carbide refractories. Where these are inadequate it might be better to choose aluminum oxide. It has only $^1/_3$ to $^1/_4$ the thermal conductivity of silicon carbide. Nevertheless, it is chemically inert to oxidizing conditions.

Other properties including permeability, modulus of rupture, spalling resistance, and porosity are factors that sometimes need thorough consideration.

Design Criteria

Several general rules apply to shape design. Extremes in thickness as well as sharp changes in cross section should be avoided. Wall thicknesses under $^1/_4$ in. are difficult to produce and are quite fragile. Thick sections and overly large shapes are affected adversely by thermal shock. Pieces classed as too large often can be sectionalized to improve performance of over-all structure. An assembly should be designed to permit easy removal and replacement of individual pieces when necessary.

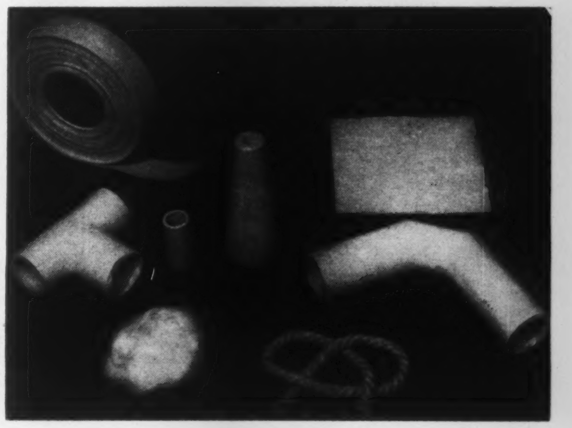
Specialized refractories are made with much closer dimensional tolerances than are possible with fire clay and other similar refractories. Of these specialized refractories, silicon-nitride-bonded silicon carbide most nearly approaches the accuracy with which metals can be produced. The material itself has an extremely low volume change during drying and firing, permitting tolerances of ±0.003 in. to ±0.005 in. per inch of dimension. Normally cast shapes have a surface finish of approximately 250 microin., whereas compacted and pressed parts have a finish of 500 microin. Surface finish of either type can be improved by grinding. If carefully done with a diamond grinding wheel, a finish of 32 microin. can be obtained.

However rugged, these nonmetallics do not have a stress-strength ratio nor yield point as is found in metals. Because these materials are strong, they are brittle and will break before bending. Sometimes redesign of shape or holding device can be effected to place the parts under compression rather than tension.

Maintaining Nonmetallics

Although they may demand more vigilance and more

Fig. 4 Various forms of aluminum silicate ceramic fiber used for insulating purposes up to 2300 F. Its *K* factor varies from 1.1 to 2.4 over different available forms at a mean temperature of 1600 F.



judgment to carry them out, there are, nevertheless, a number of refractory-maintenance guides that have proved worth while over the years. Well-designed, properly installed refractory structures serve for years with little or no repair work and with only routine inspections if small corrective actions are made before serious conditions develop.

Interiors of kilns, furnaces, and other equipment preferably should be examined daily but not less often than weekly. Operating conditions should be checked for changes in pressures, drafts, temperatures, or other measurable aspects of performance. Air or flame leakage signals the need for corrective steps.

Expansion joints and flues should be kept free of foreign matter, and slag build-up as well as accumulations on top surfaces of heat-transfer members should be removed. Loose brick should be pointed up, cracks patched, and broken tile replaced. Spalled surfaces are cause to investigate operating conditions and load stresses imposed upon the structure.

Erosion and wear also require study with the possibility of changing flow of hot gases or liquids.

After making repairs, it is good practice to prepare a detailed record as a basis for future observations. Basic dimensions should be checked and recorded. Critical spots and any special materials employed should be noted. These routine procedures and the thoroughness with which maintenance work is handled will have a marked effect on service life of specialized refractories.

Bibliography

F. C. Roe, "Do You Have Abrasion Problems—Wear Problems?" *Plant Engineering* (2 parts), June, 1958, pp. 116–118; and July, 1958, pp. 115–117.

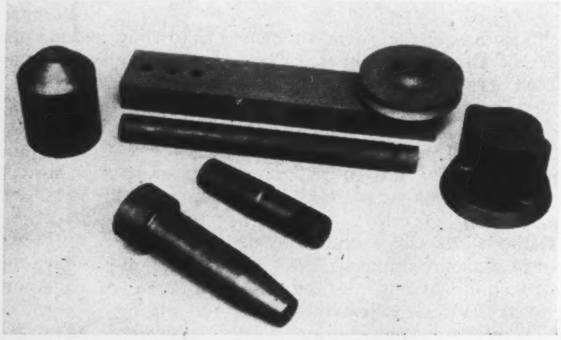
R. W. Brown, "Taking the Black Magic Out of High-Temperature Nonmetallics," *Chemical Engineering*, vol. 65, 1958, pp. 135–150.

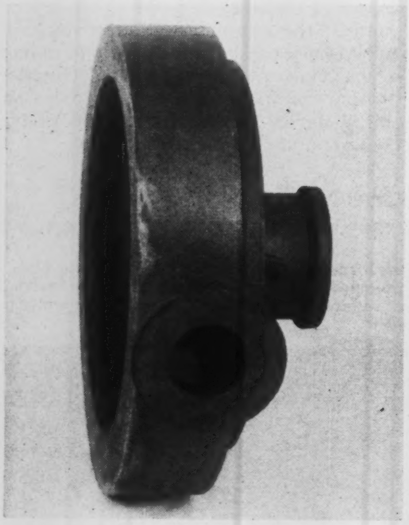
W. L. Wroten, "Nitride-Bonded Silicon Carbide Bridges Gap Between Metals and Ceramics," *Product Engineering*, February, 1957, pp. 135–139.

C. B. Walworth, "Ceramic Fiber—Seven Forms and How to Use Them," *Materials in Design Engineering*, October, 1957, pp. 124–129.

J. L. Everhart, "Silicon-Carbide Refractories Used as Alternates for Special-Service Alloys," *Materials & Methods*, November, 1951.

B. M. Johnson, A. A. Turner, and H. S. Schroeder, "Super Refractories Give Operators Unique Range of Properties," *Journal of Metals*, May, 1955, pp. 2–8.





Figs. 5–7 Typical nonmetallic shapes showing range of sizes and complex designs that can be produced

By an intensive further development effort, long-lived, high-output fuel cells can be devised which give a thermal efficiency of 70 per cent for the direct generation of electric power from fossil fuels

FUEL CELLS

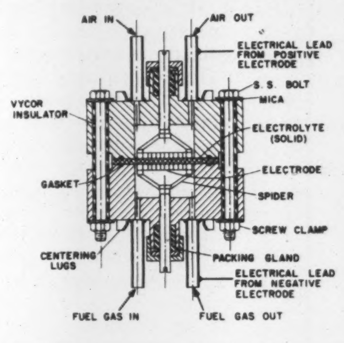


Fig. 1 Experimental high-temperature fuel cell

By Everett Gorin and Howard L. Recht

Research and Development Division, Consolidation Coal Company, Library, Pa.

Research on the fuel cell has been carried out sporadically for almost a hundred years, but there has been a decided awakening of interest in recent years. By definition, a fuel cell is a primary electrochemical device which effects the oxidation of a fuel with conversion of a substantial portion of the heat of combustion directly to electrical energy. A true fuel cell must operate continuously with a steady and constant output of electrical energy and with continuous supply of fuel to the negative electrode and of oxidant to the positive electrode. Only recently have fuel cells been devised which begin to meet this criterion of steady output.

Why is there such a widespread interest in the fuel cell? In a broad sense, the main attraction is the potentially higher efficiency that can be achieved in the conversion of natural fuels to electrical energy. It does not, in itself, introduce a new source of energy such as in the case of nuclear fission and fusion. Its main function would be to extend our resources of fossil fuels.

A number of different types of fuel cells have been under development. All cells for which any success has been claimed operate with gaseous fuels, and discussion will be limited to these. Ultimately, of course, the authors' company is interested in the use of solid fuels, particularly coal, which is by far our most abundant fossil fuel for generation of power. Prior gasification of coal can be used to produce fuel gas for use in the fuel cell. As will be discussed further, this operation can be conducted in integration with the fuel-cell process itself to produce a high potential efficiency for generation of power from coal as well as from other natural fuels.

There are really two basic types of fuel cells that have been under development. The low and medium-temperature cells operate broadly in the temperature range of room temperature to about 250 C. These cells are characterized by the fact that high output is only achieved when relatively pure hydrogen is used as the fuel and pure oxygen as the oxidant.

The most highly developed cell of this type operates at moderately elevated temperatures and at relatively high pressures of about 600 psi. This is the cell developed by F. T. Bacon[1][1] in England, whose use in this country is being developed by the Patterson Moos Division of the Universal Winding Company.

These hydrogen-oxygen cells have achieved considerable success in the course of their laboratory development. They are of interest for specialized military and possibly civilian applications. In their present state of development, however, they cannot be regarded seriously as a major power source. This is because the cost of the fuel and of the oxidant is as great as the cost of power generated directly from natural fuels by more conventional methods. Even the apparent advantage of the fuel cell for generation of power at a high efficiency level tends to disappear with this kind of cell. This can be shown by reference to Table 1. Here we see the over-all balance for a scheme where electric power is generated from methane by way of its prior conversion to hydrogen and its final combustion in a high-pressure Bacon type cell. It is seen that the over-all electrical efficiency, based on the methane feed, is somewhat smaller even than one obtains by more conventional power-generation methods.

High-Temperature Cells

The other type of cell that has been under development in various laboratories in the world is the so-called high-temperature cell. This cell is characterized by the fact that the operating temperature is above 500 C, principally in the range of 500 to 850 C; that operation is carried out at atmospheric pressure; that air can be used as the oxidant; and that ordinary fuel gases which

---

Contributed by the Fuels Division and presented at the Annual Meeting, New York, N. Y., November 30–December 5, 1958, of The American Society of Mechanical Engineers. Paper No. 58—A-200.

[1] Numbers in brackets designate References at end of paper.

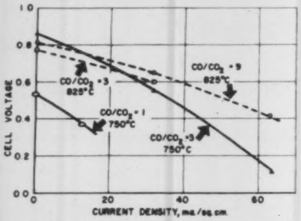


Fig. 2 Cell performance data with CO-CO$_2$ fuel gas

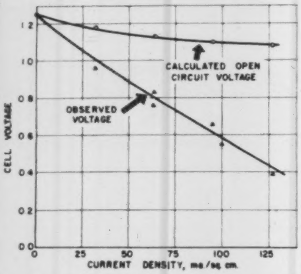


Fig. 3 Cell performance data with H_2-H_2O fuel gas at 750 C

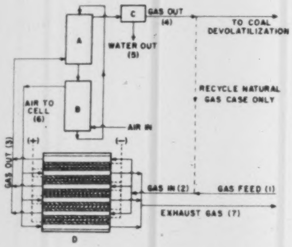


Fig. 4 Integrated fuel-cell systems

can be generated directly from coal or other fossil fuels such as water-gas can be used. The most extensive work in this field has been carried out in Holland at the University of Amsterdam under Ketelaar[2, 3]. Considerable success has been obtained in this work and cells have been devised which show steady operation at operating temperatures for periods of six months.

Experimental Work

The authors' company has been working for several years under Signal Corps sponsorship on the development of a high-temperature fuel cell. The work paralleled fairly closely that performed at Amsterdam. The type of fuel cell that was used is shown in Fig. 1. Any commercial development that arises would, in all likelihood, operate on a similar principle.

The fuel cell is composed of two flanges between which an electronically insulating but electrolytically conducting electrolyte matrix is disposed. This matrix is composed of a porous-magnesia refractory. It is impregnated with a molten carbonate mixture which serves as the electrolyte.

Two porous electrodes are disposed in the gas chambers on either side of the electrolyte matrix. Fuel gas is passed in and out of one of these chambers while air passes in and out through the other one. The air electrode is composed either of a porous sintered semiconducting nickel oxide or of silver-wire gauze. Equally good results can be obtained with either. The fuel-gas electrode can be porous sintered-nickel metal, although other materials, such as porous iron, can be used. Fig. 1 illustrates one of the authors' earlier fuel-cell models. Work is now being conducted with pressurized double-porosity-type electrodes for which much better performance is anticipated.

Good operating characteristics have been attained with these cells using carbon-monoxide carbon-dioxide mixtures as the fuel gas with an iron-activated fuel electrode. Broers and Ketelaar have obtained very good performance with a similar system where the iron activator is backed up with a silver-gauze electrode. The porous-nickel, single-porosity electrode gives fair performance with CO-CO_2 mixtures. This is illustrated in Fig. 2 where the cell voltage under steady operating conditions is shown as a function of the carbon-monoxide carbon-dioxide ratio and the current density and the temperature. The theoretical open-circuit voltage for these mixtures is of the order of one volt.

Nickel, however, operates very well as a fuel electrode when hydrogen is present. Fig. 3 shows similar data on cell operating characteristics at 750 C for a hydrogen-steam mixture as a fuel gas. The open-circuit voltage of the cell changes with current density due to change of gas composition as a result of the cell reaction. This change was calculated by means of the Nernst equation and the corrected voltage is shown as the upper curve. The *IR* drop in the cell is the difference in voltage between these two curves. It is found that the *IR* drop is equal to the resistance measured with an a-c bridge. We therefore conclude that the cell operates without polarization with a hydrogen fuel gas. No polarization was observed at the air electrode at the current densities up to 125 milliamperes per sq cm, using either lithiated nickel oxide or silver gauze.

Potential Application

What is the potential of the high-temperature fuel-cell system as a primary energy source? Several factors will determine the over-all economics of such an operation. First, the fuel cost which is a reflection of the thermal efficiency of the cell. Second, the investment and operating costs must be considered. These latter two costs are very much a function of the cost of the individual fuel-cell elements and of their life. It is difficult, at the present time, to get a realistic estimate of the cost of the elements in the fuel cell since many of the materials are either not manufactured at all or made on a very small scale. Cell life, it would appear from the authors' work and that of Ketelaar [2, 3], can be of the order of at least six months. However, the ultimate life must be larger for such a system to be practical. The cell output per unit of electrode area also will have a great bearing on the economics of the operation of the system since the cost of the individual electrode area is fairly well fixed.

The authors' work and that of Ketelaar [2, 3] have shown that a current output of the order of 35 amp per sq ft can be obtained at an operating voltage of 0.75, but a detailed theoretical analysis shows that further cell development can yield a current output of 200 amp per sq ft at the operating voltage of 0.75. Such a current output would, if the cell were sufficiently long-lived, approach that required for commercial operation.

The other important factor in the fuel cell is the over-all thermal efficiency for conversion of the original fossil fuel to electrical energy. An integrated system for effecting this conversion using either coal or natural gas as fuel is shown in Fig. 4. The scheme shown is based on the premise, which has been demonstrated by prior work, that carbon dioxide addition to the air is necessary to achieve a high-output fuel cell. We see here a high-temperature cell composed of rectangular elements disposed in parallel through which the fuel gas is passed countercurrent to the air. The system shown at *A* and *B* is a circulating-carbon-dioxide-acceptor system which operates countercurrently and adiabatically to effect the transfer of CO_2 from the exhaust gases leaving the cell to the air entering the cell. The cells have re-forming catalysts disposed in the gas channel to convert methane into CO and hydrogen. The heat released during the cell operation is available to carry out this endothermic reaction. The gas leaving the CO_2 acceptor system is rich in hydrogen and may be either simply recirculated where natural gas is used as fuel or passed through a coal hydrogenation or hydrodevolatilization zone to produce the gas required for fuel-cell operation.

An over-all heat material balance has been made around the operation of such a system based on rather extensive knowledge of the coal hydrogenation-gasification [4] operation. This balance was made around a fuel cell operating at 0.75 volt. The efficiencies for three sources of fuel to the cell are shown in Table 2. The first is gas produced by hydrodevolatilization of coal; the second is gas from complete coal hydrogenation; and the third is natural gas. It is seen that the efficiency attainable ranges up to 70 per cent for complete conversion of the coal. Another system which can be used for complete coal conversion which was not illustrated involves gasification of the coal with steam in indirect heat-exchange relationship with cell operation. Such a system shows a potential electrical efficiency as high as 75 per cent.

Table 1 Energy balance in operation of hydrogen-oxygen cell at 600 psi 1 lb mol, CH_4 as primary fuel

Gross heating value, Btu		
Methane feed	383,000	
H_2 product at 100 psig	233,000	
Electrical energy in Btu equivalents at		
Current density, amp per sq ft	9.3	93
Voltage	1.02	0.905
Produced in cell	160,800	142,500
Consumed in oxygen plant	21,500	21,500
Consumed for gas compression	14,400	14,400
Net electrical energy	124,900	106,600
Over-all electrical efficiency, in per cent	32.7	27.8

Table 2 Over-all maximum electrical efficiency

	H T Combustion, Btu
A *Coal devolatilization*	
100 lb coal to devolatilization	1,438,000
4.8 lb char burned to supply endothermic heat of devolatilization	70,000
	1,508,000
58.1 lb char product from devolatilization	844,000
Net fuel consumed	664,000
Efficiency = $\frac{100 \times \text{Btu equivalent of electrical energy at 0.75 volt}}{\text{Net fuel consumed}} =$	
$\frac{396{,}000}{664{,}000} = 59.7$ per cent	
B *Complete coal conversion*	
100 lb coal	1,438,000
Btu equivalent of electrical energy generated at 0.75 volt	998,000
Electrical efficiency $\frac{998{,}000}{1{,}438{,}000} = 69.5$ per cent	
C *Methane combustion*	
1 lb mol methane in	383,034
Btu equivalent of electrical energy at 0.75 volt	249,000
Electrical efficiency $\frac{249{,}000}{383{,}034} = 65$ per cent	

Table 3 Comparison of estimated fuel costs, nuclear and coal-based power plants

	First generation, 1960–1961	Second generation, 1963–1965	Ultimate
Nuclear fuel cost, mills per kwhr	5.8	1.7 to 2.0	1.0
Competitive coal costs, cents per million Btu			
Steam plant heat rate, 8500 Btu per kwhr	68	20 to 24	12
Fuel cell heat rate, 4850 Btu per kwhr	120	35 to 41	21

As already pointed out, nothing can be said as yet about the ultimate economics of the fuel cell. However, it is clear that the fuel cell is an extremely promising method for generation of power and that there is every indication that by further development work a cell could be developed with sufficient stability and high enough output for commercial use. It is possible to make a comparison of the fuel costs that can be achieved by use of a fuel cell operating at 70 per cent over-all thermal efficiency as compared with fuel costs involved in generation of nuclear power and by conventional steam plants based on coal. This is given in Table 3.

The fuel costs for nuclear plants are extremely uncertain and one must take the best estimate from the many available. The first generation of nuclear power plants is expected to show a fuel cost in the neighborhood of 5 to 6 mills per kwhr [5], [6]. The second generation of nuclear plants is expected to show a much lower fuel cost which is generally not too well defined. The figures shown in Table 3, of 1.7 to 2.0 mills per kwhr [5], [7], are the lowest estimates known to the authors for such second-generation plants. Similarly, ultimate nuclear fuel cost is even more indefinite, but a value of 1 mill per kwhr has been arbitrarily assigned.

It is seen that the fuel cell would permit coal to remain competitive with nuclear power on the basis of fuel cost over a much longer period than would be the case for a conventional steam plant. As a matter of fact, the figures indicate that the fuel cell could show a lower fuel cost than a nuclear plant at a location close to the coal mine for the indefinite future.

Acknowledgment

Acknowledgment is made to the U. S. Army Signal Corps whose generous financial support made this work on the fuel cell possible.

References

1 F. T. Bacon, *Beama Journal*, vol. 61, 1954, pp. 6–12.

2 J. A. A. Ketelaar, *Die Ingenieur*, vol. 66, August 20, 1954, pp. E88-91.

3 G. H. J. Broers, PhD thesis, University of Amsterdam, The Netherlands, 1958.

4 C. W. Zielke and E. Gorin, *Industrial and Engineering Chemistry*, vol. 47, 1955, pp. 820–825.

5 W. Kenneth Davis, Louis H. Roddis, Jr., and Clark Goodman, *Nucleonics*, vol. 15, 1957, pp. 90–93.

6 Paul R. Kasten and H. C. Claiborne, *Nucleonics*, vol. 14, 1956, p. 88.

7 Paul R. Kasten and Russell E. Hoen, *Industrial and Engineering Chemistry*, vol. 47, 1955, pp. 820–825.

Note: Two recent review articles on fuel cells are: F. T. Bacon and J. S. Forrest, "High-Pressure Hydrogen-Oxygen Fuel Cell," *Engineer*, vol. 202, July 20, 1956, pp. 93–94, from Fifth World Power Conference Paper No. 119K/4, Vienna, Austria, 1956; and E. K. Rideal, *Zeitschrift für Elektrochemie*, vol. 60, 1958.

THE PROFESSIONAL DIVISIONS OF THE ASME

Their Scope and Activities

The Professional Divisions Committee of the ASME, under the direction of the Board on Technology, organizes, fosters, and co-ordinates the activities of the Professional Divisions and Groups of the Society.

The Divisions take their directive from the stated objectives of the Society contained in its Constitution and in Article B 10, Paragraph 1, of the By-Laws:

"The object of each Professional Division shall be to provide, through an organization of members of any or all grades particularly interested in a branch of engineering included in the scope of the Society's activities, means for promoting the arts and sciences of that branch."

The leadership of The American Society of Mechanical Engineers adheres faithfully to the purposes defined 79 years ago at the Society's inception. The *collection and diffusion of definite and much needed information;* the *general personal acquaintance thus promoted . . . among engineers and businessmen associated with them;* the *writing and discussion of technical papers* . . . these objectives, attained today through Division Conferences and National Meetings for the entire Society, are the basic reasons why 48,000 mechanical engineers are now members of the ASME.

The Professional Divisions are the units of the ASME most closely in touch with the laboratories, production centers, and field stations where engineering takes its forward steps. The divisions receive and review the technical papers of their specialties. Many times, knowing of unreported developments, they call for papers, urging the men at the spearhead of the advance to present their findings to the profession. The publication of papers is an essential step in the ever-rising level of our technology.

The founders planned for *communication* when they organized the ASME in 1880. They'd see it in action, today. Throughout the year, presentation of technical papers takes place at Divisional Conferences at cities all over the country. At mid-year, there is a Semi-annual Meeting of all the divisions. In November there takes place the Annual Meeting, attended nowadays by more than 5000 engineers who hear and discuss some 300 technical papers.

The year sees approximately 800 technical papers produced, reviewed, published, and presented. That is the forum the ASME provides, for its members and the industries they represent.

AVIATION Division *Organized 1920*

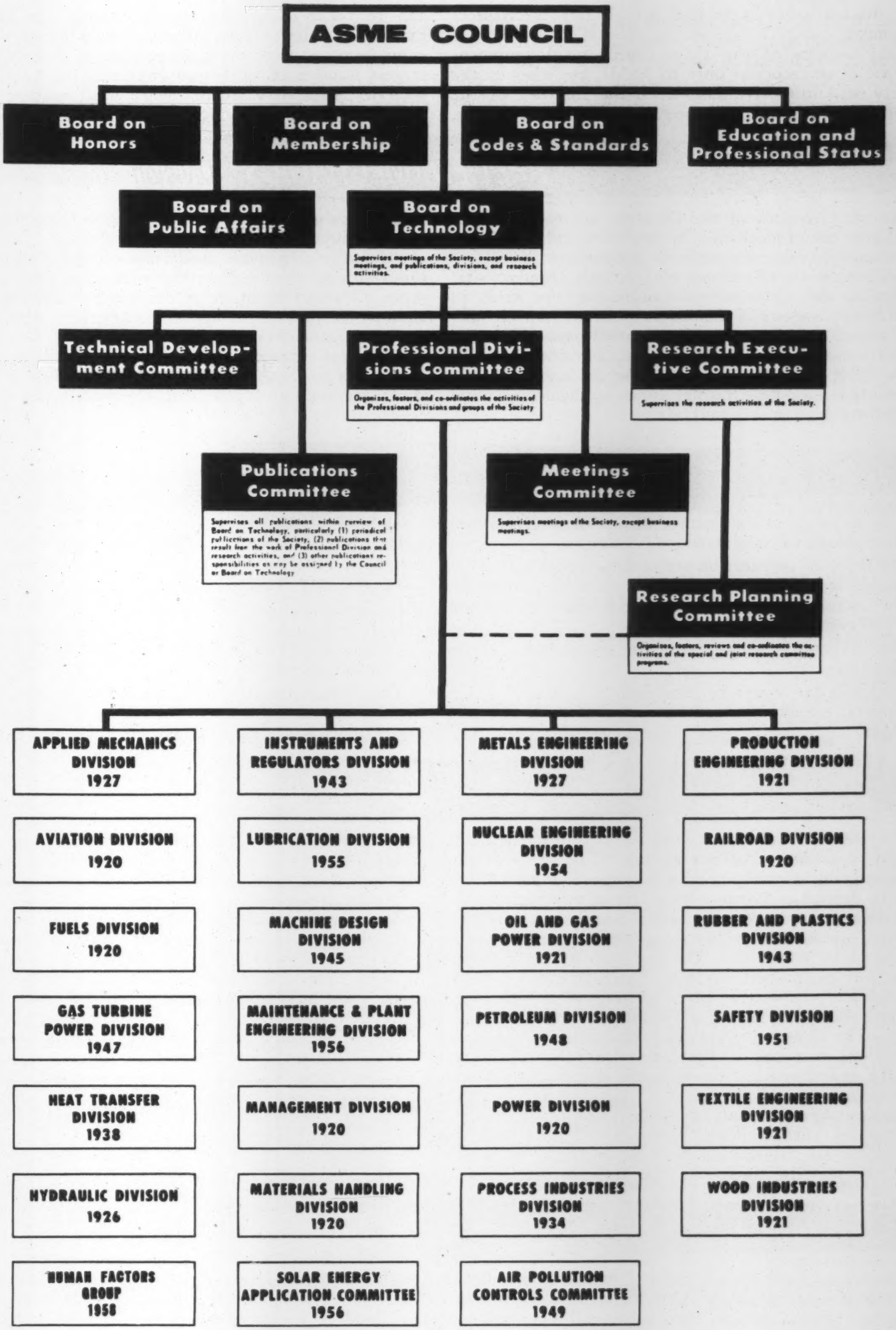
The Aviation Division sponsors technical sessions on the mechanical-engineering aspects of aircraft and missile design. This field includes both the vehicles themselves and installed and associated equipment, such as aircraft power plants (reciprocating, turboprop, turbojet, ramjet, and rockets), cabin-pressurizing systems, landing-gear systems, aircraft-control systems, air-cargo materials-handling equipment, technical problems associated with passenger and crew comfort, and missile operational support systems and specialized test facilities and practices.

Papers cover subjects such as analytical studies, research, design, development, manufacturing, test, and operation of aircraft mechanical equipment. The human-engineering aspects of the design problem are given detailed attention.

Aircraft-mechanical-equipment subjects are often of interest to other ASME divisions. Whenever this is the case, Aviation Division invites other divisions to cosponsor the session. For example, Gas Turbine Power Division is invited to cosponsor sessions where aircraft-gas-turbine subjects of mutual interest are discussed. Applied Mechanics Division, Instruments and Regulators Division, and Materials Handling Division are other divisions which have been invited to cosponsor sessions of common interest. Conversely, these divisions invite Aviation Division to cosponsor their sessions whenever

---

Contributed by the Professional Divisions Committee of The American Society of Mechanical Engineers.


ASME COUNCIL
Board on Honors
Board on Membership
Board on Codes & Standards
Board on Education and Professional Status
Board on Public Affairs
Board on Technology
Technical Development Committee
Professional Divisions Committee
Research Executive Committee
Publications Committee
Meetings Committee
Research Planning Committee
APPLIED MECHANICS DIVISION 1927
INSTRUMENTS AND REGULATORS DIVISION 1943
METALS ENGINEERING DIVISION 1927
PRODUCTION ENGINEERING DIVISION 1921
AVIATION DIVISION 1920
LUBRICATION DIVISION 1955
NUCLEAR ENGINEERING DIVISION 1954
RAILROAD DIVISION 1920
FUELS DIVISION 1920
MACHINE DESIGN DIVISION 1945
OIL AND GAS POWER DIVISION 1921
RUBBER AND PLASTICS DIVISION 1943
GAS TURBINE POWER DIVISION 1947
MAINTENANCE & PLANT ENGINEERING DIVISION 1956
PETROLEUM DIVISION 1948
SAFETY DIVISION 1951
HEAT TRANSFER DIVISION 1938
MANAGEMENT DIVISION 1920
POWER DIVISION 1920
TEXTILE ENGINEERING DIVISION 1921
HYDRAULIC DIVISION 1926
MATERIALS HANDLING DIVISION 1920
PROCESS INDUSTRIES DIVISION 1934
WOOD INDUSTRIES DIVISION 1921
HUMAN FACTORS GROUP 1958
SOLAR ENERGY APPLICATION COMMITTEE 1956
AIR POLLUTION CONTROLS COMMITTEE 1949

Supervises meetings of the Society, except business meetings, and publications, divisions, and research activities.

Organizes, fosters, and co-ordinates the activities of the Professional Divisions and groups of the Society

Supervises the research activities of the Society.

Supervises all publications within purview of Board on Technology, particularly (1) periodical publications of the Society, (2) publications that result from the work of Professional Division and research activities, and (3) other publications responsibilities as may be assigned by the Council or Board on Technology

Supervises meetings of the Society, except business meetings.

Organizes, fosters, reviews and co-ordinates the activities of the special and joint research committee programs.

they discuss subjects related to aircraft mechanical equipment.

Many aspects of the aircraft-mechanical-equipment field are of interest not only to ASME but also to the Society of Automotive Engineers, the Institute of the Aeronautical Sciences, and the American Rocket Society, and in these cases overlapping among the Societies exists. In order to bring information on the mechanical-engineering aspects of flight-equipment design to the largest number of interested engineers in the different societies, there is a trend toward joint sponsorship of sessions.

APPLIED MECHANICS Division *Organized 1927*

The over-all aims of the Division are to foster the intelligent use of mechanics by engineers and to develop this science to serve the needs of engineering.

Mechanics is construed to include fundamental analytical and experimental studies in the fields of elasticity, plasticity, dynamics, vibration, impact, flow and fracture, structures, stress analysis, mechanical properties of materials, hydraulics, aerodynamics, internal flow, turbulence, boundary layers, aeroelasticity, thermodynamics, heat transfer, lubrication and wear, and computing devices and methods.

These subjects cover a large part of engineering and overlap the fields of interest of many other Divisions of the Society. In such fields the Applied Mechanics Division concerns itself chiefly with basic laws and the more advanced methods of studying problems, rather than with the very large and important field of the application of these laws and methods to the infinite variety of practical engineering problems. The Division's desire is to serve and co-operate with other divisions and to supplement their activities in these fields.

FUELS Division *Organized 1920*

It is the function and purpose of the Fuels Division to provide means for stimulating advancement in:

The fields of preparation and utilization of fuels.
The design and operation of fuel-burning equipment.
The control and utilization of the products of burning processes.

The Division provides a common ground for all who are interested in:

Coal, oil, gas, waste, or other fuels.
Stokers, pulverizers, and burners (for coal, oil, and gas).
Boiler and process combustion chambers.
Heat exchangers, dust collectors, and other related equipment.

The Division co-ordinates some of its activities with these other professional divisions of the ASME: Aviation, Gas Turbine Power, Railroad, Materials Handling, Instruments and Regulators, Nuclear Engineering, Power, and Management.

The Division encourages and sponsors research and development in its fields of interest, and the adoption of codes to define accepted practices in the use of fuels.

GAS TURBINE POWER Division *Organized 1947*

The Gas Turbine Power Division is interested in the design, operation, and application of all types of gas-turbine prime movers. For this purpose, a gas turbine may be defined as a form of heat engine in which a pressure differential of working fluid is established by a compressor, and in which a large part of the net output is produced by a turbine. The Division fosters development of gas-turbine technology, encourages experimental and theoretical investigations of design, construction, and operation, and explores fields of application. The Division promotes exchange of information about gas turbines, co-operates with other interested groups and divisions, co-ordinates technical data and developments, and disseminates information through presentation, discussion, and publication of papers.

The Gas Turbine Power Division naturally overlaps all industrial divisions which cover fields in which turbines may be used. At the present time this is most apparent in the aviation and power generation fields. The divisions concerned are aware of this overlap and have taken steps to insure co-ordination of effort by appointing liaison representatives and by co-sponsoring sessions of mutual interest.

Liaison has been established with the following organizations whose interests are parallel to those of the Gas Turbine Power Division in some fields, and who have appointed representatives to the Gas Turbine Power Division: American Institute of Electrical Engineers; American Rocket Society; American Society of Naval Architects and Marine Engineers; Institute of the Aeronautic Sciences; National Aeronautics and Space Administration; Society of Automotive Engineers; U. S. Army, Corps of Engineers; U. S. Army, Ordnance; U. S. Army, Transporation Corps; U. S. Navy, Bureau of Aeronautics; U. S. Navy, Bureau of Ships; U. S. Navy, Bureau of Yards and Docks.

HEAT TRANSFER Division *Organized 1938*

The scope of the Heat Transfer Division is very broad in that it concerns itself with a fundamental thermodynamic process which cuts across all the fields of engineering endeavor. Hardly a process or a product is carried out without some phase of heat transfer being involved in its make-up, either directly or indirectly.

The entire field of heating and air conditioning is a fundamental application of one or more heat-transfer processes. The broad field of metals manufacture and fabricating involves one or more of these processes.

The Heat Transfer Division serves a large proportion of the total ASME membership and keeps them regularly informed on its activities and interests. Its many technical committees serve the various specialized applications of broad scope and the more fundamental technical branches of the art. The committees are made up of specialists who are actively engaged in work in the particular field, so that new problems and approaches are constantly being given prompt attention. These committees serve primarily to focus attention on important work in the field and encourage authors to publicize their works through the medium of ASME publications.

Particularly active and timely subjects are given special emphasis and attention, sometimes through the medium of symposiums, with leaders in that field participating. The Heat Transfer Division sponsors technical sessions at the various Society meetings and has co-operated with other Divisions in meetings.

The Division is a cosponsor of the Heat Transfer and Fluid Mechanics Institute held on the Pacific Coast each year. It also sponsors jointly with the American Institute of Chemical Engineers, the National Heat Transfer Conference. In 1951 the Division organized the American participation in the International Heat Transfer Conference in London. The Second International Heat Transfer Conference to be held in the United States, in 1961, will be sponsored jointly by this Division and the AIChE.

The Heat Transfer Division, because of its broad field of application, has many interests which are common to the Power Division, Fuels Division, Oil and Gas Power Division, Hydraulic Division, Gas Turbine Power Division, Aviation Division, Nuclear Engineering Division, and Process Industries Division. The Division maintains liaison with these as well as with the AIEE and the AIChE.

HYDRAULIC Division *Organized 1926*

The Hydraulic Division embraces the broad field of the mechanics of fluid motion. Some of the aspects of this field of particular interest to the divisions are: The exchange of energy between fluids and machines; the motion of fluids, such as viscosity, density, and compressibility, upon their flow characteristics; cavitation and cavitation damage; and water hammer and surge phenomena.

Although the term "hydraulics" sometimes implies a restriction of the field to that of the flow of liquids, this is not true in the case of the Hydraulic Division. The flow of compressible fluids is included in its scope. In this respect it has common interests with several other of the Society divisions. In general, the Hydraulic Division limits its interests to cases in which the exchange of energy in the form of heat is not an essential part of the process.

The interests of the Hydraulic Division include research, development, design, construction, installation, operation, and maintenance. It follows that a significant part of the activities of the Division is devoted to the field of hydraulic machinery—turbines, pumps, compressors, clutches, and torque converters—since these aspects of fluid flow are of importance in this field.

The Division is particularly interested in fundamental research in hydrodynamics, since it is only through the discovery of new facts and the development of keener analytical tools that the profession advances. In this phase of its activities the Hydraulic Division is particularly close to the Applied Mechanics Division and welcomes such co-operative activities as joint projects, joint sponsorship of technical sessions, and so on. Similar co-operation is welcomed in all of the other activities of the Division, not only for other divisions of ASME but also from its sister engineering societies.

INSTRUMENTS and REGULATORS Division *Organized 1943*

The Division's objective is the promotion of professional-level engineering and science pertaining to the theory, design, and application of instruments for the measurement of variables, the processing of this information and control of equipment or system based on such measurements.

The Division encourages and arranges the writing, presentation, discussion, and publication of professional-grade papers; promotes common terminology; encourages teaching in the field; promotes standardization; and selects and sponsors research projects.

Since many other divisions of ASME and many other socieities find measurement and control a necessary part of their area of interest, the Instruments and Regulators Division has made a major part of its activity the co-operation and liason with these other groups. The Division seeks a common denominator of their problems as an aid to solutions, and thus has a segmental interest in Applied Mechanics, Aviation, Gas Turbine Power, Heat Transfer, Machine Design, Metals Engineering, Oil and Gas Power, Petroleum, Power, Process Industries, Production Engineering, Rubber and Plastics, Textile, and Wood Industries.

The Division has participated in meetings with many of these ASME divisions, and is in the process of establishing an annual intersociety instrumentation and control conference in conjunction with committes and groups of AIEE, AIChE, IRE, and ISA. To further the intersociety co-operation, the Division has participated in the formation of the American Automatic Control Council and International Federation of Automatic Control.

LUBRICATION Division *Organized 1955*

The Lubrication Division is established to serve the members of the Society interested in lubrication problems in the mechanical-engineering field and to afford to them a means for discussion and solution of the many complex problems arising from their work within this specialized field of their activities. It also provides an opportunity for others, not members of the ASME, who are interested in and concerned with these lubrication problems, to associate in the discussion and solution of these problems.

The field of interest of the Lubrication Division cuts across those of other divisions of the Society wherever lubrication enters into design, manufacture, or operation. It includes promotion of research in the fundamental aspects of lubrication and the dissemination of such information in the form of papers at conferences and regular meetings of the Society. It also includes the preparation of manuals on recommended design, operating, and maintenance practices, to the extent that these affect the lubrication of equipment.

The Lubrication Division has in its organization various Committees needed to cover adequately this multiplicity of interests, and to co-ordinate efforts with other divisions and technical societies. There are four Technical Committees, designated as the Research, Lubricants, Design, and Builders and Operators Technical Committees, with scopes as suggested by their designations.

MACHINE DESIGN Division *Organized 1945*

The Machine Design Division is broadly concerned with the concept, development, and design of machines. This involves the application of the basic sciences, a practical knowledge of manufacturing methods, appreciation of the human factors, and an understanding of economics.

The Division is specifically concerned with vibration, noise, analysis, and synthesis of motions and mechanics, utilization of materials in the elastic and plastic ranges, systematizing and classification of components, stress analysis, and many similar aspects of machinery as well as the broader aspects of design-department management, standardization, safety, styling, and specifications. The broad spectrum of skills, abilities, and knowledge coupled with need for creativity, ingenuity, and common sense, results in a large area of interests for technical papers, committee programs, and opportunities for conferences and co-operative activities.

It is a major objective of the Division to help keep its membership abreast of the many and rapid technical developments which affect the design of machinery. This is done by papers presented at meetings and conferences on matters of current interest as well as highly technical papers of permanent interest. The Division co-operates with engineering schools in the motivation of students toward design careers.

The Division activities frequently involve co-operation and liaison among the other divisions and societies.

MAINTENANCE and PLANT ENGINEERING Division *Organized 1956*

The scope of activity of this group shall be to promote the art and science of mechanical engineering in the field of maintenance and plant engineering. In particular it shall cover the following:

1 Managerial and control aspects, including (*a*) organization of the maintenance and plant engineering function; (*b*) planning, budgeting, scheduling, work-order systems, together with the administration of maintenance work; (*c*) cost analysis and history record systems; (*d*) preventive maintenance inspection procedures.

2 Analysis and corrective action of maintenance problems including the development and use of modern instruments, tools, methods, and techniques for both the analysis and corrective action.

3 Design modifications of equipment and facilities to reduce maintenance costs, together with improved techniques and procedures for the rapid transmission of such information from maintenance personnel to design personnel.

4 Design, procurement, and installation of additions or alterations to buildings, equipment, or facilities.

5 Provision and maintenance of utility services such as electricity, steam, water, gas, and compressed air required for production.

6 Salvage and disposal of obsolete and scrap equipment.

The work in this field of activity shall be promoted in the following manner:

1 Afford mechanical engineers a means for discussion and solution of the many and varied complex problems in this specialized field of activity.

2 Encourage and foster research and development, and the publication of significant data in this field.

3 Encourage the interchange of ideas among engineers, through the promotion of the preparation and publication of papers and the organization of programs in which papers are presented and discussed.

4 Direct attention to outstanding engineering achievement in this field, and recommend suitable recognition.

5 Provide that the activities of the group shall be directed by members of the Society who have attained prominence and prestige in this field of activity.

6 Co-operate with the other divisions in the foregoing where there are common interests.

MANAGEMENT Division *Organized 1920*

Management is the art and science of planning, organizing, measuring, and directing human effort applied to control, and utilize the forces and the materials of nature to achieve objectives in the most effective and efficient manner.

The objectives of the Management Division are: (*a*) To improve management by the application of engineering science and the engineering point of view. (*b*) To serve the management interests of: ASME members who are interested in learning management techniques and improving their management abilities; managers of engineering functions; engineers in general management; engineers of management, who are concerned with the development and application of management skills and knowledge; colleges and universities engaged in developing engineers for management.

The Division may undertake action to:

1 Determine the need for original and applied research in the fields of management, organize and sponsor committees for research programs, and encourage and guide their work.

2 Spread knowledge in the field of management to engineers and managers by encouraging the preparation, presentation, and publication of papers.

3 Plan timely programs so that meetings will be interesting, informative, and inspiring, and design programs for the cross-fertilization of ideas in engineering and management.

4 Develop and stimulate new means of advancing engineering knowledge and the application of engineering methods in the fields of management.

5 Bring to the associate members of ASME a full and professional concept of management, and aid those who aspire to management work.

6 Stimulate and encourage leadership in the fields of management where ASME, as an engineering society, is better able to serve than other organizations.

7 Attract men of character, vision, and ability to ASME membership by the high quality of purposes and accomplishments of the Division's activities and by invitation to participate in the Division's work.

8 Maintain close liaison and co-operate with the Sections, Divisions, and Committees of ASME in furthering interest in the fields of management.

9 Co-operate with other societies in promoting the objects of the Division and the Society.

10 Assist in the development and application of better management practices in small and large industries, services, and economic units.

11 Stimulate and increase international management activities by developing an exchange of management procedures, skills, and important management literature with engineering management groups abroad.

12 Further the engineering point of view and the application of engineering principles to management-employee relationships, human and public relations.

13 Co-operate with colleges and universities in the extension and improvement of sound curriculums in the teaching of management principles, practices, and techniques.

14 Encourage management in industry to develop a better understanding of its responsibilities to the owners, employees, customers, and general public, and how it can most usefully serve the best interests of groups.

15 Encourage the development of affiliated committees for the advancement of specialized functions within the general framework of the Management Division.

MATERIALS HANDLING Division *Organized 1920*

The Materials Handling Division recognizes its responsibility to lend all possible assistance to the establishment of efficient, economical materials-handling practices in all areas of industry and commerce. Among the regular activities pointing toward this goal are the development of safety codes, mechanical standards, and recommended practices relating to materials-handling equipment and its related machinery.

The Division considers the term, "materials-handling equipment," to include such machinery as cableways, conveyers, cranes, hoists, monorail carriers, industrial trucks, trailers, and tractors; pneumatic conveyers for objects or bulk materials; elevators, lifts, and auxiliary devices such as pallets, containers, weighing and metering equipment, adjustable docks, and so on.

The Division is deeply interested in developing sounder theory and better analytical techniques for materials-handling work, and encourages papers.

The Division also concerns itself with the layout and planning of plant facilities utilizing the foregoing equipment, and the problem of effecting a tie-in of those facilities with transportation systems, whether rail, air, or sea-borne cargo. In connection with materials handling and storage of bulk materials such as coal, ore, sand, grain, and various bulk-food material, the Division concerns itself with the development of scientific investigations of various phenomena governing the flow of bulk solids, so that the design engineer may have available reliable design criteria for design of materials-handling equipment and storage facilities. Another interest of the Division is the improvement of distribution through better methods of packaging, packing, and preparing for shipment.

The Division has a horizontal interest which coincides with that of many other ASME Professional Divisions including Management, Production Engineering, Aviation, Process Industries, Railroad, Machine Design, Textile Engineering, Power, Wood Industries, and others.

The Materials Handling Division co-ordinates portions of its program with other organizations as represented by the American Material Handling Society, the Society of Industrial Packaging and Materials Handling Engineers, the Society for the Advancement of Management, the Conveyor Equipment Manufacturers Association, the Material Handling Institute, and others.

METALS ENGINEERING Division *Organized 1927*

The Metals Engineering Division has as its objectives: To foster and encourage research into basic principles and techniques of metal forming (excluding chip-producing processes); to promote the integration of the techniques of metal forming from the purely scientific side into products, machinery, and plants on the production side; to disseminate information on metals engineering through presentation, discussion, and publication of papers; to co-operate with other divisions of the Society and with other scientific groups in promulgating these objectives.

The Metals Engineering Division is interested in promoting better knowledge of the use and design of metals in structural parts. It encourages the dissemination of information concerning new metals and processing methods, testing procedures, and the interpretation of test data as an aid in design. This involves the practical application of metallurgical principles to obtain economics in metal usage. In brief, the Division desires to effect a better engineering application of metals.

In pursuing its purposes the Division sponsors technical meetings at which papers are presented and discussed. Typically representative of this field are the following areas of study:

Design (finished products and equipment)
Cold working (drawing, stamping, bending, etc.)
Hot working (rolling, forging, extruding, etc.)
Casting (sand, metal mold, centrifugal, investment)
Joining (welding, soldering, powder metallurgy, etc.)
Techniques of heat-treatment
Mechanical aspects of making ferrous and nonferrous metals, to the extent that these influence subsequent utilization.

Since the economical use of metals is basic to most mechanical engineering, the Division is guided in all of its activity by a desire to make available and useful to all mechanical engineers the data concerning metals and metal-forming processes which are most needed.

The Division has been privileged to hold sessions with other divisions when the subject indicates a purpose useful to ASME would be accomplished by such joint effort. Likewise, co-operative work is carried on with other societies wherever desirable, through the Executive Committee and liaison members.

NUCLEAR ENGINEERING Division *Organized 1954*

Objectives of the Nuclear Engineering Division are:

To constitute a Professional Division of the ASME, in accordance with the Society's Constitution, By-Laws, and Rules, in the field of nuclear engineering.

To promote the art and science in "those areas of mechanical engineering in which a knowledge of nuclear physics is essential."

To stimulate and develop a continuing program of activity dealing with the application of nuclear energy.

To encourage and foster research and development, and to summarize and publish reliable data of engineering importance about subjects within the Division's scope.

To extend appropriate leadership and co-operation in the development of national codes and standards.

To enhance the interchange of ideas among engineers and technologists by (*a*) encouraging the preparation and publication of papers on technical developments; (*b*) organizing programs in which papers are presented and discussed, and in which all members of the Society may meet on an equal basis to exchange experiences and technical data; (*c*) co-operating with other Professional Divisions, Groups, and Committees within the Society, and with other societies, to avoid duplication of effort and conflicts with respect to standardization, research, preparation of papers, meetings, and special services.

To direct attention to outstanding engineering achievement in the nuclear field, with recommendations and suggestions as to recognition for such achievement.

OIL and GAS POWER Division *Organized 1921*

The Oil and Gas Power Division deals with internal-combustion engines and auxiliaries—their design, construction, application, and operation. In addition to diesel, gas, and dual-fuel engines as complete units, this naturally includes basic components—injection and ignition systems, bearings, pistons and rings, cylinder liners and heads, crank and camshafts, connecting rods, valves and valve gear, scavenging blowers and superchargers, etc. It also includes the auxiliary equipment needed for a complete internal-combustion-engine power plant for stationary, marine, railroad, or mobile application; air filters and silencers, exhaust mufflers and waste-heat recovery devices, cooling systems, fuel-handling and storage equipment, lubrication systems, couplings and drives for power transmission, foundations, and buildings, etc.

The Division likewise concerns itself with the characteristics and properties of fuels and lubricants, the materials used in engine construction, and the fundamental processes involved in engine operation—combustion, fluid mechanics, heat transfer, thermodynamics of working cycles, etc.

Because the Division enlists the interest of all those concerned with internal-combustion engines—those who design and build them, those who select and apply them, and those who operate and maintain them—its technical papers range from theoretical analysis to practical discussions of operation and maintenance.

The Division has always shown a strong interest in the economics of internal-combustion engines. In addition to presenting papers on this subject, it has published an annual report on oil-engine-power cost for the past 20 years. Prepared by a subcommittee, this report tabulates and summarizes the cost experience reported by actual plants. It has gained world-wide acceptance for its authoritative and unbiased presentation of greatly needed information.

The use of internal-combustion engines in the fields of special interest of other divisions of ASME makes it desirable for joint discussion of mutual problems and joint activities in the form of cosponsored technical meetings. As an example, the Oil and Gas Power Division frequently joins forces with the Railroad Division for the presentation of papers on diesel-electric locomotives. In like manner, the Oil and Gas Power Division has cosponsored sessions with the Aviation and Power Divisions, dealing with the application of internal-combustion engines in aircraft and as prime movers for electric power generation. The Division has also co-operated with the Heat Transfer and Applied Mechanics Divisions, and the Lubrication Co-ordinating Committee, on papers dealing with these subjects as applied to internal-combustion engines.

The Diesel Engine Activity of the Society of Automotive Engineers is also concerned with internal-combustion engines, especially in respect to their application in mobile installations. Jointly sponsored meetings have been held with this group. In a similar manner, the Oil and Gas Power Division has joined with the Society of Naval Architects and Marine Engineers for discussion of the use of internal-combustion engines in marine applications.

PETROLEUM Division *Organized 1948*

The Petroleum Division was established to afford mechanical engineers in the petroleum industry a means for the discussion and solution of the many complex problems arising from their work within this specialized field of activity. Within the framework of the Petroleum Division, there are various specialized activities separate from, although related to, the other segments of the industry in drilling for oil, producing, transporting, and refining it, and delivering it to consumer markets. Committee activities are provided for each branch of the industry.

Within the drilling and production committee, all the mechanical problems associated with drilling for oil and gas, completing walls, and producing crude oil and natural gas are included, together with research associated with these activities, and the mechanical aspects of equipment used in servicing drilling and production activities.

Within the scope of the Transportation Committee come the operation, maintenance, and control of pipelines, pumps, engines, and all related equipment required in the movement of crude petroleum, natural gas, and refined or extracted products from field to refinery and from refinery to consumer markets.

The Refining Committee encompasses the mechanical aspects of refining crude oil, the production of petrochemicals from crude oil and natural gas, and the manufacture and processing of other gas products. This committee also takes an active interest in and provides a forum for discussion of codes and standards sponsored by ASME for design of equipment used in these fields.

Cutting across the specialized areas of activity of the above committees, the Manufacturers' Committee covers that segment of the industry concerned with the design, manufacture, testing, and stress analysis of mechanical equipment which is used in all phases of the industry.

In like manner, the Materials Committee broadly encompasses the performance, processing, welding, and application of various materials in all parts of the industry.

With the object of promoting the science of mechanical engineering, as applied to these special needs of the ever-broadening petroleum industry, the Division sponsors an annual Petroleum Mechanical Engineering Conference during which technical papers sponsored by each of the above operating committees are presented, reviewed, and discussed. Such papers include mechanical-engineering aspects of the industry from the practical experiences of operators to the theoretical stress analyses.

To further the Division's objectives, staff committees are maintained in addition to the operating committees. These cover various phases of the Division's activities such as membership development, press publicity, research, sections liaison, and students and recent graduates. An Advisory Committee composed of past chairmen of the Petroleum Division serves in the capacity indicated by its title and as the Honors Committee for the Division.

While the functions of mechanical engineers engaged in petroleum work are peculiar to the industry, much is basic to the problems encountered in the activities of other Divisions of the Society. Accordingly, the Petroleum Division co-operates closely with these other groups, both within and outside of ASME, who have related fundamental problems. Through such liaison, the Division provides the means for the mechanical engineer in the petroleum industry to further consolidate and centralize the best of the current thinking and developments on subject matters directly associated with him and applicable to his work.

POWER Division *Organized 1920*

The Power Division is concerned with the fields of power generation and usage. Through Professional publications, meetings, and discussions, this Division provides a single forum for the benefit of those engineers who have a broad interest in the selection, operation, and utilization of all power and fuel using equipment.

In consideration of the efficient, economical, and safe conversion of energy sources to generation of power, the following broad fields of interest are included within its scope: Thermodynamics, application of nuclear energy to power generation, economics, fuel preparation and combustion, steam generation at various pressures and temperatures, utilization of steam in prime movers, recovery of unexpended heat and condensate, feedwater preparation, materials of construction, research on materials, and methods to effect greater economic power generation and utilization of increased steam pressures and temperatures, analysis and utilization of various operating cycles within the steam generating system. In addition, the Power Division supports research committees, standardization committees, the Boiler Code Committees and subcommittees under a general grouping, Power Test Codes Committees.

Since there is such a broad coverage of interests, the Power Division co-operates with the following Professional Divisions on specific problems: Applied Mechanics, Fuels, Gas Turbine Power, Heat Transfer, Hydraulic, Instruments and Regulators, Machine Design, Management, Materials Handling, Metals Engineering, Oil and Gas Power, Petroleum, Nuclear Engineering, Lubrication, and Solar Energy Applicaton Committee.

The Power Division maintains liaison with the following Societies: AIEE, American Society of Naval Architects and Marine Engineers, AIChE, ASTM, and the Edison Electric Institute. Co-operation and liaison have also been established and conducted with the American Power Conference.

PROCESS INDUSTRIES Division *Organized 1934*

The function of the Process Industries Division is to provide a meeting place and clearinghouse for the exchange of information among mechanical engineers in the process industry. A process industry is understood to be an industry employing unit processes and unit operation in converting raw materials into finished products; such processing changes the character of the materials in a physical, or physical and chemical way. These industries include the chemical, food, gas, vegetable oil, sanitation, and other industries which are primarily process in character.

The PID's interests lie primarily in the mechanical-engineering phases of process industries and are mainly concerned with unit operations rather than with chemical reactions.

The Division is organized by unit operations and by industries. The separate committees under the former heading include air conditioning and refrigeration, distillation and evaporation, drying, fluids handling, heat pumps, and mechanical separation. The Functioning Industry Committees include food manufacture, manufactured and natural gas, pulp and paper, sanitation, vegetable oils, and water and waste conditioning.

Process Industries Division shares a common interest with the Wood Industries Division. With regard to gas, the Oil and Gas Power Division, the Fuel Division, and the PID are all concerned, each with a particular phase of the over-all picture. Both the Materials Handling Division and the PID are interested in plant layout and utilization of equipment. The Management Division also has a joint concern with the PID in most efficient operation of unit processes.

The Division maintains liaison with the American Institute of Chemical Engineers, the American Ceramic Society, and the Technical Association of the Pulp and Paper Industry.

PRODUCTION ENGINEERING Division *Organized 1921*

The Production Engineering Division originally considered its field the machining and assembly of metal parts with their related problems in the foundry and forge shop, and the design, construction, and improvement of machine tools, small tools, and related equipment. Subsequently the scope was broadened to include mechanical-engineering aspects of small lot and mass production of products not strictly limited to the metalworking field. The activities of the Division include:

1 Foundry and forge practice.
2 Welding—gas, arc, and resistance.
3 Cutting and forming of metals.
4 Methods of product assembly.
5 Design of jigs, fixtures, dies, cutting tools, and special machinery and attachments for production.
6 Product inspection and measurement, including gage design and application, surface finish, and the practical aspects of quality control.
7 Flow of materials and co-ordination of materials-handling equipment and methods with machine equipment, and the production cycle.
8 Developments in machine tools, power transmissions, and other machinery which affect production.
9 Methods analysis, production scheduling, and plant layout as they affect the production cycle.
10 Studies of cutting action and application of cutting tools of the various cutting alloys.
11 Studies of grinding, honing, and lapping, and the application of abrasives in production.
12 Lubrication and coolants as they are used in production machinery and in machining processes.

The Production Engineering Division includes members interested in managerial and other broad phases of product manufacture as well as those more specifically interested in design, automation, metal cutting, etc. The Division arranges for joint sponsorship of technical sessions accordingly.

RAILROAD Division *Organized 1920*

The ASME is the only important technical organization in which railroad officers and representatives of railway-supply manufacturers are eligible for membership on the same basis. For that reason, the Railroad Division of the Society offers a common meeting ground for the engineers of the railroads and the manufacturers.

The Railroad Division was formed primarily to serve those members who are engaged in branches of the railroad industry involving the work of a mechanical engineer. The Division aims to furnish to members of the Society, through papers presented at its general meetings and at meetings of local Sections or otherwise, information on the progress of mechanical engineering in railroad practice. Engineering management and the training of mechanical engineers for railroad work are covered by the Division in close co-operation with the Management Division.

The Railroad Division activities include studies of research, design, construction, operation, and maintenance of railroad locomotives, cars, and appurtenances. Any other subjects which can be classified as railroad mechanical engineering are also included. Locomotives include steam, diesel-electric, gas-turbine electric, and straight electric. Where separate power plants such as diesel engines or gas turbines are used on locomotives, the power plants themselves are generally covered by other divisions such as Oil and Gas Power or Gas Turbine Power. As soon as the power plant is mounted in the locomotive, however, its application, performance, etc., become subjects for the Railroad Division. The general subjects of braking, safety, passenger comfort, lading protection, and train operation are included; also servicing, repair, and shop facilities. Testing of railroad mechanical equipment, particularly for strength, performance, and efficiency, is included.

Several other organizations are working in the same general field. The American Railway Engineering Association, for example, takes up subjects involving railroad track and roadway, as does the American Society of Civil Engineers. Subjects involving railroad operation and maintenance of equipment are being considered by the American Railway Association.

RUBBER and PLASTICS Division *Organized 1943*

The Rubber and Plastics Division embraces all aspects of manufacture and use of rubber and plastics relating to mechanical engineering. Activities of the Division include planning and sponsoring of programs relating to rubber and plastics at national meetings of the ASME, and at other meetings in co-operation with local sections or with other technical societies, and participating in committee work relating to rubber or plastics that is of concern to ASME.

The Rubber and Plastics Division shares a common interest with other professionl divisions. For example, stress analysis of rubber and plastic components is of mutual interest to the Applied Mechanics Division. Rubber and plastics are widely used in the aircraft and railroad industries which are of interest to the Aviation Division and the Railroad Division, respectively. The design of machinery for processing rubber and plastics is of mutual interest to the Machine Design Division. Adhesives are of interest to several divisions, particularly the Wood Industries Division, because of their extensive use in bonding plywood.

The Rubber and Plastics Division co-operates with other technical organizations interested in rubber and plastics. Some of these organizations are: Division of Rubber Chemistry, American Chemical Society; committees D11, D14, and D20, American Society for Testing Materials; Committee on Safety Codes for Rubber Machinery, American Standards Association; Society of Plastics Engineers; Society of Plastics Industry.

SAFETY Division *Organized 1951*

The Safety Division is broadly concerned with the application of the basic principles and disciplines of the sciences for the purpose of reducing personal injury and/or property losses through control of the factors that cause accidents.

The Division encourages and fosters research and development, and summarizes and publishes reliable data of engineering importance pertaining to subjects within the Division's scope of activities. It encourages the interchange of ideas among engineers and technologists. The activities of the Division are directed by members of the Society who have attained prominence and prestige in the field of safety.

The Division proceeds by: (*a*) Encouraging the preparation and publication of papers on technical developments; (*b*) organizing programs in which papers are presented and discussed, and in which all members of the Society may meet on an equal basis to exchange experiences and technical data; (*c*) co-operating with other professional divisions, groups, and committees within the Society, and with other societies with respect to standardization, research, preparation of papers, meetings, and special services, and in the avoidance of duplication of effort and conflicts.

The Division's interest will be engaged by activities in the area of education, as well as in engineering. Its interests may overlap those of many other divisions, and in such instances proposed activities will be undertaken co-operatively whenever practicable. Therefore, although the Division's activities may be more intensely devoted to industrial accident-prevention matters, it will be understood that its scope of endeavor includes all phases of the safety problem related to the area of interest inherent in mechanical engineering.

The following examples of topics that have been before the Division are included to identify generally the areas of safety engineering, without intending to establish specific limits of interest: (*a*) Industry environment control includes ventilation, noise, and illumination, etc.; (*b*) machine guarding; (*c*) mechanical equipment, including elevators, escalators, pressure vessels, cranes, derricks, hoists, conveyers, cable waves, metal and woodworking machines, refrigeration equipment, mills and calenders, abrasive wheels, hand tools, etc.; (*d*) personal protective equipment; (*e*) toxic and explosive dust and gases; (*f*) supervision and management; (*g*) process and operations layout design; (*h*) maintenance; (*i*) testing; (*j*) safety codes; (*k*) safety program; (*l*) human factors in engineering; (*m*) radiation hazard and protection.

TEXTILE ENGINEERING Division *Organized 1921*

The primary purpose of the Textile Engineering Division is to enlist greatest possible interest and co-operation of the mechanical engineer in the many varied and complex problems of the textile industry. The future progress of this oldest of industries depends to a large extent upon the work of the mechanical engineer in applying engineering sciences to the art of textile manufacturing.

Improvement and development of textile processes and machinery constitute a fertile field for mechanical research and better machine design. The many engineering problems involved in the design, construction, and equipment of the modern textile mill demand the best engineering talent available.

The Division plans to co-operate to the fullest extent possible with all existing textile associations for the benefit of the industry and the Society. It will also undertake the collection and distribution of such important data on textile-engineering subjects as will be of greatest assistance to its membership.

The Division asks the co-operation and assistance of all members of the Society interested in the textile and allied industries to further the aforesaid purpose.

WOOD INDUSTRIES Division *Organized 1921*

The Wood Industries Division is interested in wood from the tree to the finished product. This includes the engineering aspects of forestry, forest fire-fighting equipment, logging, saw mill, and all the subsequent wood-machining operations that enter into the plywood, furniture, and kindred industries.

The Division is naturally interested in the bonding of woods; that is, the adhesive problem as well as the various finishing processes and methods. It has a new subcommittee on Wood-Cutting Tools and Equipment. This committee has made an excellent start on a program which is expected to stimulate considerable interest among the manufacturers and users of woodworking machinery.

The Wood Industries Division overlaps many other divisions.

The Division has a subcommittee on Forest Protection sponsored by ASME in co-operation with the Society of American Foresters. The educational field is also an important phase of the Division's activities, particularly wood research. In a recent meeting, one of the features of the program was a symposium on wood research in which representatives of various types of research organizations—Federal, universities, commercial, and industries—discussed the ways in which each contribute to the development of the wood industry. It is notable that several colleges are now offering furniture or wood-technology courses.

To summarize, the purpose of the Division is to stimulate research in wood and to promote the adoption of better and more efficient manufacturing methods in the whole field of wood utilization.

HUMAN FACTORS Group

Organized 1958

The objectives of the Human Factors Group are:

1 To encourage in engineering practice the attention to human factors required in the development of physical designs in order to (*a*) maximize the performance of man-machine systems, and (*b*) minimize the problems that arise from improper man-machine interactions.

2 To promote better communications between practicing engineers and human-factors scientists so that (*a*) the human-factors scientist may be acquainted with real problems and undertake appropriate researches, and (*b*) engineers have access to pertinent available knowledge of human capacities and limitations.

The fields of interest regarded as within the scope include: Any system into which man may be introduced—or any system, equipment, product, tool, or method in which there is human influence on production, operation, or maintenance. The principal concerns are with speed, accuracy, and reliability of man-machine performance in the human use and operation of equipment and systems, and in the short and long-range effects of the man-machine-environment system on the health and well-being of man. Particular emphasis is on system dynamics and on displays for presenting information to human senses, controls for human operation, the layout of workplaces, and the control of the human environment.

The basic nonengineering sciences whose specialties are prominently allied with ASME's interest in human factors include: psychology, physiology, sociology, anthropometry, and medicine.

AIR POLLUTION CONTROLS Committee

Organized 1949

Authorized—"To initiate and co-ordinate research concerning the health, comfort, nuisance, engineering, and economic aspects of the problem; to collaborate in the formulation and publication of standards of appropriate nature; and to encourage and assist in the preparation, presentation, and publication of papers on the many phases of atmospheric pollution."

SOLAR ENERGY APPLICATION Committee

Organized 1956

The Solar Energy Application Committee was established to provide a means of developing and providing a center of professional activity in the field of solar energy as provided in the following scope:

> "To stimulate and develop a continuing program of Society activity dealing with the application of solar energy."

Abstracts and Comments Based on Current Periodicals and Events

D. FREIDAY
Assistant Editor

BRIEFING THE RECORD

Bus Trains

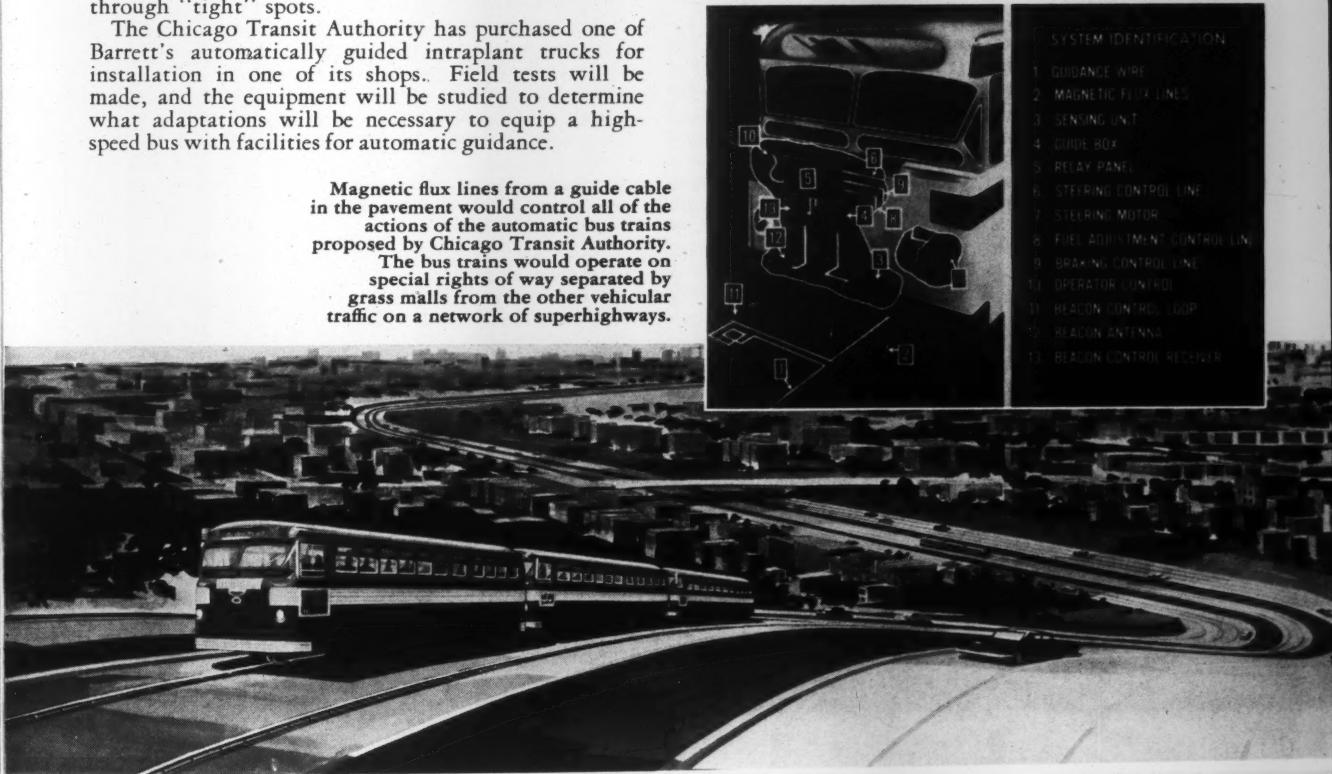
CHICAGO TRANSIT AUTHORITY has done considerable research on the possibility of operating "automatically guided bus trains." These would be used to provide fast interurban service on special rights of way in the center of superhighways and separated from other vehicular traffic by grass malls.

A guidance wire embedded in the center of each traffic lane would generate magnetic flux lines picked up by the sensing unit on the bus. These would regulate speed and provide steering and braking control.

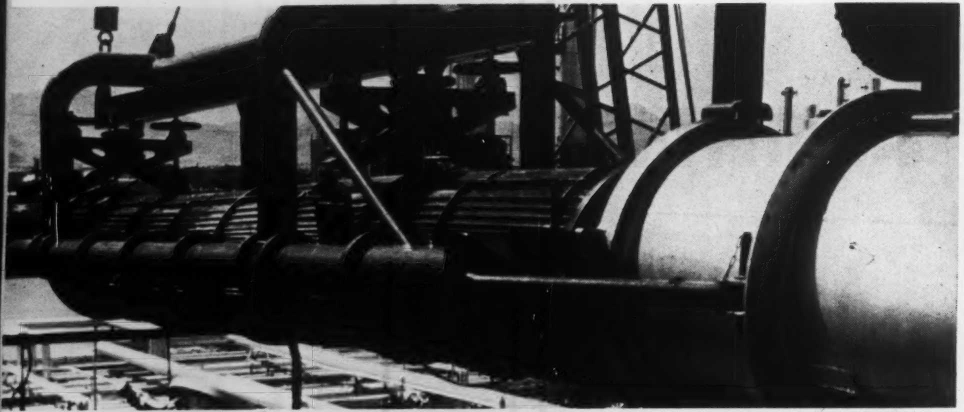
The equipment would be a modification of the Guide-O-Matic system manufactured by Barrett Electronic Corporation, Northbrook, Ill., and already used for operatorless trains of tractors and trucks used for materials handling in industrial plants. Although these move at only 2 to 3 mph, it has been proved in practice that materials are moved as fast or faster than with manually operated vehicles moving at higher speeds. Routes laid out by engineers are balanced to the material flow, following planned routes. The same accuracy is maintained each trip down aisles, around corners, and through congested areas. Stops are made at only preselected points and no time is wasted in jockeying through "tight" spots.

The Chicago Transit Authority has purchased one of Barrett's automatically guided intraplant trucks for installation in one of its shops. Field tests will be made, and the equipment will be studied to determine what adaptations will be necessary to equip a high-speed bus with facilities for automatic guidance.

An automatic control system, already installed on industrial tractors for materials handling in industrial plants, would be the basis of the control system


10
6
5
9
13
4
8
12
3
11
2
1
SYSTEM IDENTIFICATION
1 GUIDANCE WIRE
2 MAGNETIC FLUX LINES
3 SENSING UNIT
4 GUIDE BOX
5 RELAY PANEL
6 STEERING CONTROL LINE
7 STEERING MOTOR
8 FUEL ADJUSTMENT CONTROL LINE
9 BRAKING CONTROL LINE
10 OPERATOR CONTROL
11 BEACON CONTROL LOOP
12 BEACON ANTENNA
13 BEACON CONTROL RECEIVER

Magnetic flux lines from a guide cable in the pavement would control all of the actions of the automatic bus trains proposed by Chicago Transit Authority. The bus trains would operate on special rights of way separated by grass malls from the other vehicular traffic on a network of superhighways.



A tube bundle is inserted in the heat-exchanger shell in about 40 min, including the time needed to connect the extractor brackets to the exchanger shell

The extractor is connected to the end of the vessel for bundle insertion. Frequent inspection of tube bundles is facilitated.

Heat-Exchanger Tube-Bundle Extractor

Designed to speed up the handling of heat-exchanger tube bundles and to save maintenance dollars, a lightweight, portable tube-bundle extractor is operating successfully at the El Paso Texas Refinery of the Standard Oil Company of Texas, a subsidiary of Standard Oil Company of California. It is now planned to make the puller commercially available for use in process plants.

Removing, handling, and inserting heavy tube bundles in horizontal shell-and-tube heat exchangers is a major item of petroleum-process-plant maintenance cost. Present commonly used methods are: (*a*) Temporary rigs for winching or jacking the bundle into a crane sling—this is slow, hazardous, and results in high labor costs; (*b*) expensive, permanent steel structures with overhead monorails and hoists—this alternative results in substantial idle investment during the long periods between seasonal exchanger maintenance operations.

Included in a recent expansion of the Sotex refinery were 30 large exchangers elevated from 20 to 50 ft above grade. Since a suitable yard crane was available at the refinery, it was decided to design a lightweight, portable mechanical extractor. Principal design features of the equipment invented by W. R. Postlewaite, of the Company's engineering department, are: (*a*) Light welded frame with integral monorail; (*b*) two adjustable trolley slings; (*c*) actuator head with 20-ft-6-in. stroke for extraction or insertion, driven by two 25-ft-long, air-powered screws which are rated at 30,000 lb total pull at a speed of 2 fpm, or a maximum of 40,000 lb with the air motor installed; (*d*) two portable adapters to allow rapid mounting of the extractor on the exchanger shell, designed to automatically center the extractor to always give a straight axial pull; (*e*) the extractor weighs 5260 lb empty, and handles bundles up to 36 in. in diam, weighing 15,000 lb when dirty; (*f*) in use at El Paso, the extractor is slung from a 25-ton wagon crane with an 80-ft boom. This rig can reach exchangers 60 ft above ground.

A crew of three men, plus the crane operator and oiler, can insert a bundle from the ground into an elevated exchanger in about 40 min including time to connect the extractor brackets to the exchanger shell. This compares with a crew of 8 to 10 men for 3 or 4 hr to insert an elevated bundle using customary winching or jacking methods.

For a complete in-and-out handling cycle, the extractor offers an average savings over older methods of about $200 per bundle. Including the cost of the welded bracket connections on the heat exchanger, it is estimated that the extractor will pay out in about three years after taxes.

Also attractive to operators are the ease and speed of handling, making practical more frequent bundle inspection and replacements to maintain high plant efficiency between shutdowns, and the safe handling of elevated bundles obtained with this dual-sling machine.

A large version Model II extractor included in a patent application is now being designed to handle bundles ranging from 20 to 48 in. in diam.

Human-Factors Instrumentation

A 20-LB PACKAGE of medical instruments that will monitor the physiological stresses and general condition of the human subject in manned space flights without requiring the presence of a medical technician has been developed by the Vibro-Ceramics Division, Gulton Industries, Inc., Metuchen, N. J.

The miniaturized electronic system can be worn comfortably and can withstand the extreme environmental conditions in space and take-off acceleration.

Continuous and accurate bioelectric and physical information can be provided on six physiological parameters. These will be blood pressure, heart rate, heart sounds, respiration rate and depth, skin temperature from many points, and galvanic skin resistance.

An occluded cuff at the finger will provide blood-pressure measurements. A microphone pickup mounted in the pressurized cuff will relay the sounds and, by utilizing the time of appearance and disappearance, will measure systolic pressure. Measurement of the sensitive blood-pressure changes will indicate the subject's reaction to abnormal environmental conditions.

In measuring the heart rate, the electrocardiogram wave form will be used to measure the contraction of the heart muscle as an indication of cardiac disorders. Animal studies have indicated that heart rate has been $3^1/_2$ times normal under missile or rocket take-off.

A ceramic microphone that performs the function of a stethoscope is mounted in an elastic chest band and positioned over the heart to determine the malfunctions of valves.

Respiration rate and depth will be measured by a resistance-type strain gage mounted in a face mask. In the wave forms that will be produced by breathing through the mask, the rate of the major waves will determine the respiration rate, and the amplitude is calibrated in terms of flow rate so that the peaks and troughs yield respiration depth. The readings will indicate if the subject is undergoing strain, if he is coughing or gasping, and his breathing reactions to high speed, elevated temperatures, and rarefied atmosphere.

Thermistors embedded in steel, located on the forehead, chest, back, arms, and legs will serve as the temperature-sensing probes and will make it possible to record skin temperatures from anywhere on the body within a half second. The instruments are so sensitive that if the subject is a nonsmoker, a puff on a cigarette will immediately indicate a temperature change.

Galvanic resistance will be measured and recorded from electrodes contained inside flexible spats placed on the insteps of both feet. Changes in skin resistance determine the changes in emotional activity or response of the subject and his reactions to stimuli. The subject's skin resistance will change in anticipation of a danger within seconds after he becomes aware of it.

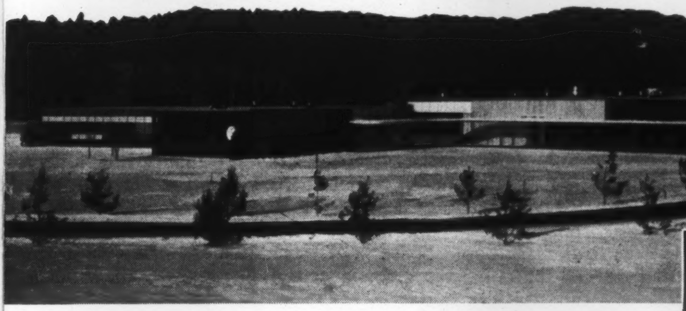
The data provided by the instrumentation can be recorded or can be telemetered back to earth as required.

Split Ball Bearing Plant

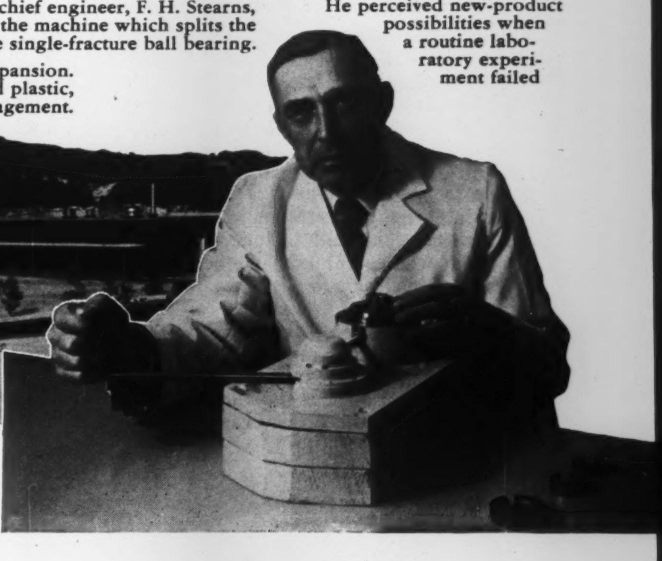
SPLIT BALL BEARING, a division of Miniature Precision Bearings, Inc., has recently moved into its new plant at Lebanon, N. H., a plant designed exclusively to produce the company's "single-split" ball bearings which use the fractured-race technique. The patented single-split bearing, with its extremely high load factor, is one of those engineering developments that had its origin in a laboratory mischance—a case where something went wrong and an alert engineer sensed possibilities of a new product.

The original split ball bearings, first made three decades ago, had the inner or outer races—or both—broken in half to permit assembly in otherwise impossible installations. Not only could they be divided for assembly, but they could be loaded with more balls than the usual Conrad type, giving high load factor, and they could carry thrust loads impossible in the loading-slot type. The fractured metal fitted back together to make a smooth ball race. Disadvantage: The reassembly required that the rings be wide enough to accommodate bolts, causing the bearing to take up twice the normal space. Machines requiring the double-fracture ball bearings are literally designed around the bearings.

One day in 1949, an outer ring failed to fracture on both sides, though it had been double-scored on its outer surface in the usual manner. It was discovered that the ring, with its single fracture, could be opened enough to load the bearing with balls—and then closed by a simple shroud ring. Result: A new bearing, no wider than any other, with high load factor, high thrust capacity, and long life. Second result: A plant that was new in 1952 has now been replaced by a larger one designed for rapid expansion.



The new one-story plant permits practically unlimited expansion. Pour a slab of concrete, erect walls of steel, aluminum, and plastic, and... "We can double our size in a week," says the company management.



Split Ball Bearing's chief engineer, F. H. Stearns, shown with the machine which splits the prescored outer race of the single-fracture ball bearing.

He perceived new-product possibilities when a routine laboratory experiment failed

Mechanical Fuel-Cladding Removal

For many fuel types of nuclear-fuel reprocessing it would be desirable to remove the cladding material mechanically, according to the quarterly review on *Reactor Fuel Processing* prepared for the Atomic Energy Commission by Argonne National Laboratory.

There are two types of mechanical removal—disassembly and dejacketing. Disassembly is the separation of structural components from active individual fuel pins, rods, or plates and will probably be done at the reactor site. Dejacketing is the removal of the cladding metals used to contain fissionable and fertile material in the individual pins, rods, or plates and will probably be carried out at the reprocessing plant. With heterogeneous fuel elements some form of disassembly may always be required. However, experience with dejacketing and active core cutting has been limited, and much development work must be done before mechanical exposure and cutting of core materials become competitive with chemical dissolution of cladding materials and/or cores.

Mechanical processing offers the important advantages of smaller aqueous-waste volumes, the use of less corrosive reagents for dissolving the fuel material when the difficult-to-dissolve cladding is removed, and increased plant capacity in the absence of dissolved cladding material to process streams. With some proposed fuels, mechanical removal of jackets makes continuous fuel dissolution possible.

Some of the disadvantages are the problems arising from radiation-induced slug distortion and the use of bonding agents. Operating costs are high because of the complex machines and buildings needed for removal operations and the necessity for maintaining sealed and possibly chemically inert cell atmospheres. Problems of containment and cleanup of the water, air, or inert gas used as the working medium must be solved along with development of production machines that can be operated and maintained remotely.

Culler and Blanco reported at Geneva that, of the many mechanical dejacketing methods studied, rolling, milling, extrusion, abrasive cutting, electrical-discharge cutting, and shearing are effective for unbonded or NaK-bonded fuels. Only rolling and shearing appear applicable to metallurgically bonded fuels.

In work at Hanford a circular saw operating at 16,000 linear fpm was satisfactory for cutting bundles of stainless-steel rods and bundles of ceramic-filled stainless-steel tubing. Recent studies have shown that a speed of 22,000 linear fpm is required to cut massive stainless-steel fuel elements.

Nuclear Auxiliary Power

A small nuclear device for the production of electricity in satellites, navigational aids, and other areas where a low wattage is required, was recently demonstrated by the Atomic Energy Commission at a White House press conference. The 5-lb, $4^{3}/_{4}$-in-diam, $5^{1}/_{2}$-in-high thermoelectric converter is fueled with $^{1}/_{3}$ of a gram of polonium which produces 5 watts of electricity for the 140-day half life of the Po-210 at an efficiency of 8 to 10 per cent, far greater than that for any other known thermocouple device developed to date. After the first 140-day half life, output is 3 watts with an efficiency of between 5 and 6 per cent.

Called SNAP III—for System for Nuclear Auxiliary Power Program of the Aircraft Reactors Group—it is estimated that in the course of 280 days it could produce a quantity of electricity equal to the output of 1450 lb of the best conventional batteries.

The device generates electricity by utilizing 750-F heat in 20 pairs of thermocouples radiating from the centrally placed fuel. These semiconductors are constructed of lead telluride alloyed with other substances including bismuth and manganese.

SNAP III was developed for the AEC under a $15,000 contract by the Martin Company of Baltimore, Md., in conjunction with the Minnesota Mining and Manufacturing Company of St. Paul, Minn. Production cost in quantity was estimated at $200.

At present prices the amount of polonium fuel required is valued at about $30 million, hardly a practical figure. However, it is anticipated that radioactive waste products now unutilized could serve as fuel.

Nuclear Briefs

▶ 500 to 2000 Psi and Nuclear Superheat

Westinghouse Electric Corporation in a joint undertaking with the General Public Utilities system, and Gilbert Associates, Inc., of Reading, Pa., will build a 5000-kw pressurized-water nuclear reactor. The plant will be "hooked on" to an existing turbine-generator unit at the Saxton, Pa., station of the Pennsylvania Electric Company of Johnstown, Pa., for operation during the summer of 1961.

An intensive research and development program at the Saxton plant will include studies directed toward increasing the useful life and heat-generating capacity of various nuclear core designs and to greatly advance the technology of all water-cooled and moderated reactors. Phenomena associated with pressurized and boiling water will be investigated in the 500 to 2000-psi range. Some of the experimental work will include an investigation of nuclear superheating.

In addition to the Pennsylvania Electric firm, General Public Utilities system is comprised of four other major wholly owned subsidiaries: New Jersey Power and Light Company of Denville, N. J.; Jersey Central Power and Light Company, Asbury Park, N. J; the Metropolitan Edison Company, Reading, Pa; and Manila Electric Company, Manila, P. I.

Westinghouse has retained Gilbert Associates, Inc., as subcontractors for engineering and construction of the facility.

▶ Aerojet to Build Nuclear Testing Reactor

A permit for Aerojet-General Corporation to construct a nuclear testing reactor near its present San Ramon, Calif., facilities has been applied for from the AEC. The 10-mw pool-type reactor to be built of standard components will yield a peak thermal neutron flux of 3×10^{14} n/cm^{2} sec for various test loops, and will incorporate the new technique of peaking the flux at a central test loop. Space will be available on a commercial basis. Two one-megacurie hot cells will be adjacent to the reactor.

▶ Nuclear-Powered Hydrofoil-Ship Design

The Grumman Aircraft Engineering Corporation has successfully completed tests of the feasibility of a 1000-ton nuclear-powered hydrofoil ship which could carry 320 passengers at a speed of 65 knots. The tests reported by the Maritime Administration were announced in the *Forum Memo* of the Atomic Industrial Forum.

Under power, the ship would rise out of the water on three legs which in turn would ride on airplanelike wings about 6 ft below the surface of the water. The nuclear-propulsion system would be contained in a streamlined capsule beneath the water on a fourth leg.

▶ Nuclear-Powered Guided-Missile Sub

The atomic engine and the propulsion equipment for the *Halibut*, SSG-N-587, the first nuclear-powered submarine capable of firing a guided missile, recently launched at the U. S. Navy's Mare Island, Calif., shipyard, were designed and developed by Westinghouse Electric Corporation under the direction of and in technical co-operation with the Naval Reactors Branch of the AEC.

The *Halibut's* pressurized-water-type reactor, although similar in principle to those of the *Nautilus* and *Skate*, incorporates new concepts and advances in reactor design that permitted construction of a smaller craft.

▶ Tandem-Compound Turbine for Nuclear Service

Steam turbines designed for use with nuclear power plants to date have operated with saturated steam at relatively low temperature. An exception to this is the 250-mw, 1800-rpm steam turbine being built by the Westinghouse Electric Corporation for the Indian Point Station of the Consolidated Edison Company of New York.

This unit will operate with a separately fired superheater. Inlet steam conditions to the turbine are 355 psig, 100 F, and 1-in-Hg-abs exhaust pressure.

In general, the characteristics of this turbine are similar to those of the intermediate and low-pressure elements of large conventional cross-compound reheat turbines. Because of the large volumetric flow to the turbine exhaust, two rows of 44-in. exhaust blades are used. This will be the largest tandem-compound 1800-rpm turbine Westinghouse has built.

……

Materials Briefs

▶ Iron-Aluminum-Manganese Alloy Family

A NEW FAMILY of iron-aluminum-manganese alloys developed by National Research Corporation, Cambridge, Mass., in connection with a program sponsored by the materials branch of the Navy's Bureau of Aeronautics, combines light weight, excellent cold workability, high-temperature strength, and oxidation resistance. It gives promise of producing a low-cost, high-temperature alloy without the use of strategic stockpile metals such as chromium and nickel. It may lead to an important technological break-through in production of a lower cost alloy for numerous high-temperature applications in the aircraft, missiles, automotive, and other industries.

Composition is 10 per cent aluminum, 34.4 per cent manganese, 0.76 per cent carbon, and the balance iron.

The new steels are austenitic in structure and are about 15 per cent lighter than carbon steel or 18-8 stainless, and 20 to 25 per cent lighter than the cobalt-and-nickel-base superalloys.

Strain aging by heat-treatment following cold working provides even higher strength in increased hardness after products are formed in contrast to austenitic stainless steels of the chromium-nickel type which normally soften, lose strength, and stress-relieve if heated after cold working. When the NRC alloy is worked above 60 per cent, a hardness increase of 7 to 8 points Rockwell A is obtained upon aging. Extrapolating 18-8 austenitic hardness versus strength data, tensile strength approaching 250,000 psi may be attainable.

Oxidation resistance has been shown adequate to 1500 F. A 100-hr test gave only 0.0065-in. surface oxidation. Other alloys in the group showed even slower rates of oxidation, with sacrifice of some mechanical properties.

Cold-working properties approximate those of 18-8 stainless.

Machinability is approximately equivalent to that of 304 stainless steel.

In addition to beneficial strain aging and high-temperature characteristics (1200 F), the new alloy promises strength-to-weight ratios higher than most of the presently available metals.

▶ Corrosion and Heat-Resistant Stainless

A new type of corrosion and heat-resistant stainless steel for service at 900 to 1600 F, known as Armco 22-4-9, has been developed by Armco Steel Corporation. The material is available as forging billets and rounds from $^{3}/_{8}$ to 3 in., inclusive.

Chemical composition in percentages is: Carbon 0.45–0.60, manganese 7.00–10.00, phosphorus 0.045 max, sulfur 0.12 max, silicon 1.00 max, chromium 20.00–23.00, nickel 3.00–5.00, nitrogen 0.30–0.50.

Among its uses are high-temperature steam valves and gas-turbine parts.

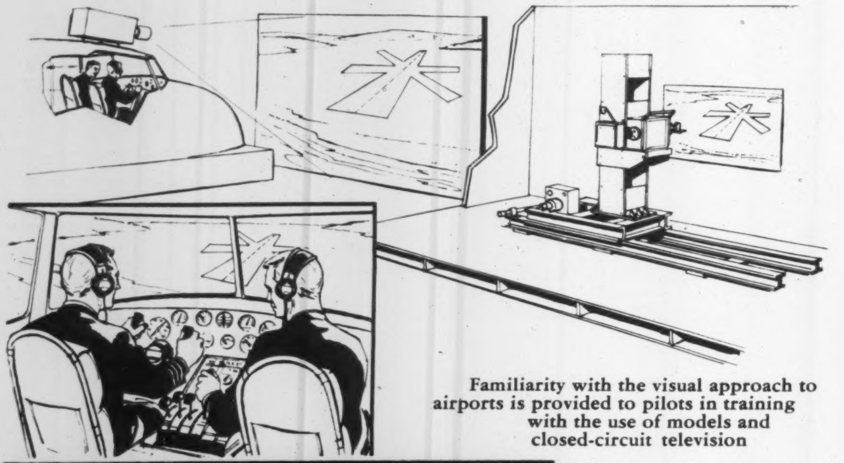
At room temperature 22-4-9 exhibits a controlled hardness between Brinell 300 and 550, depending on the method of processing. Being austenitic, and due to its composition and heat treatment, the 22-4-9 alloy maintains a relatively high degree of hardness and strength at elevated temperatures. For example, this material with an initial room-temperature hardness of Brinell 344 exhibited a hot hardness of Brinell 250 at 1100 F after 1000 hr at that temperature.

Armco 22-4-9 is nonmagnetic. Its maximum magnetic permeability remains under 1.02. This property and the other characteristics of the alloy make it of interest for use in such applications as nonmagnetic ball and roller bearings.

Owing to its high room and elevated temperature hardness, 22-4-9 is more resistant to wear, erosion, galling, and seizing than other austenitic materials.

▶ Sound Absorption of Polyurethane Foams

Polyurethane foams have excellent sound-absorbing properties according to tests by the Cornell Aeronautical Laboratory, Buffalo, N. Y. An acoustically good sound attenuation of 22 to 25 decibels was afforded in the frequency range of 1000 to 8000 cps.



Familiarity with the visual approach to airports is provided to pilots in training with the use of models and closed-circuit television

The television-taking lens in the specially designed optical system is smaller than a wooden match head

Electronic Flight Visulator

A compact, realistic, and economical closed-circuit-television system for the practice of one of the most vital phases of flight—the making of visual take-offs and landings—was demonstrated recently by the Curtiss-Wright Corporation at its Electronics Division, Carlstadt, N. J.

Key to this advance is a new electronic flight Visulator which provides a "pilot's eye" view of any airport in the world.

Visulator is a Curtiss-Wright trade name for its new device to simulate visual flight.

When an aircraft breaks out of the overcast, its pilot sees the airport and surrounding terrain. So it is with visulation, or simulated vision—the pilot now sees in true perspective his entire airport as well as the runway upon which he is about to land. Thus the gap between present-day simulation and real life is virtually closed.

The major advance in the Visulator is the unique manner in which high-fidelity closed-circuit television is utilized to permit unprogrammed visual landings after instrument flight rule (IFR) approaches.

No matter how accurately a pilot flies an instrument approach, safety dictates that at some point the pilot must be able to see—to land the aircraft by visual reference to the ground.

Never before has it been possible for pilots to practice this exacting transition procedure on the ground.

Landing decisions must be made quickly: Where is the runway? Is the plane too high? Too low? Is it aligned with the runway centerline? Corrections must be made in seconds. The allowable time will be even shorter in the new commercial jets.

A panoramic TV screen directly in front of the Flight Simulator supplies all the answers. Thus a pilot can become familiar with any airport and surrounding terrain—in advance of actual flight to the terminal.

As in earlier Curtiss-Wright simulators, the pilot flies as though he were in an actual plane in flight. Even the sounds of flying are reproduced for added realism.

The Visulator works in conjunction with a miniature relief map mounted on a wall which represents the landing and take-off facilities of an airport. A suitably supported television camera is equipped with a specially designed optical system capable of focusing images of the relief map onto the image-orthicon tube of the television camera.

By a closed-circuit-TV system, the image as received by the television camera is projected on a large screen in front of the cockpit. By operating the instruments and levers in the cockpit, the pilot sees a changing projected view that simulates actual views during take-off and landing maneuvers over a specific airfield.

Perkin-Elmer designed and manufactured the optical system for attachment to the television camera. The system produces an image of the three-dimensional scale model on the orthicon tube. The optics are mounted in a mechanical system in such a way that, by rotating parts or all of the optical elements, the three rotational movements of an aircraft (rotation in azimuth, elevation or pitch, and roll) are perfectly simulated.

To accomplish this simulation, the movements of the corresponding optical elements are driven by servomotors at specific angular velocities and acceleration, and controlled by the operations of the pilot in training.

The exceedingly small scale of the three-dimensional map, designed in miniature in order to keep the size of the simulator room to a minimum, required unusually small pick-up lenses.

The miniature models, exact replicas of en route and destination airports, are readily interchangeable. Thus, simulated take-off might originate at New York's Idlewild airport and fly by instruments all the way to Chicago until cleared to enter the local traffic pattern at

Midway airport. Upon breaking out at some predetermined ceiling, the pilot "sees" Midway.

Nothing is preset. The terrain, buildings, runways—everything—appear in relation to the precise altitude and flight path being followed by the Simulator. The panoramic view changes to correspond with every movement of the Simulator, just as the scene changes through the windshield of a moving plane.

As the final approach is made, the television camera automatically adjusts itself to angle, perspective, and focus until the wheels strike the runway.

The Simulator-Visulator combination of course also responds to all the malfunctions and weather bedevilments which instructors faithfully create in the interest of sharpening the pilot's skills.

Diesel Power Engines

The Detroit Diesel Engine Division of General Motors has added eight new basic units to its line of 2-cycle diesel engines. Formerly covering the 30 to 893-hp range the GM Diesel line has been broadened into a truly "all-purpose" power line offering single, multiple, and turbopowered engines ranging from 20 to 1650 hp.

There are now 13 basic engines and six multiple units which bring the advantages of diesel power to many applications where gasoline engines have heretofore served as the principal source of power.

In the lower power ranges, compact, lighter-weight units offer diesel economy, dependability, and durability to such industrial equipment as fork-lift trucks, loaders, conveyers, and hoists; small tractors, pumps, compressors, and stand-by generators; small industrial yard locomotives; and shovels and cranes of capacities as low as $^1/_2$ yard.

GM Diesel's new engines are based on the latest improved design which was brought out in the Series 71E engines in 1957 for even greater economy and efficiency. A new "53" series includes, 2, 3, and 4-cylinder "in-line" engines of 47, 97, and 130-max-bhp, respectively, and a compact V-type 6-cyl engine of 195 max bhp. New V-type engines in the "71" series include a 6-cyl unit, 6V-71, of 252 max bhp; an 8V-71 of 334 max hp; a 12V-71 of 504 max hp; and a 675-hp 16V-71. The 12V-71 and 16V-71 engines are "twinned" for higher horsepower needs, and turbocharging of all models from 6V-53 on up will be announced later. The 16V-71 twin engine, when turbocharged, will produce up to 1650 max bhp.

Well over 2,300,000 diesel engines are in use in this country alone. Total horsepower is unknown, but GM alone has produced an accumulated capacity of over 78,000,000 hp in the past 20 years.

Gear Checker

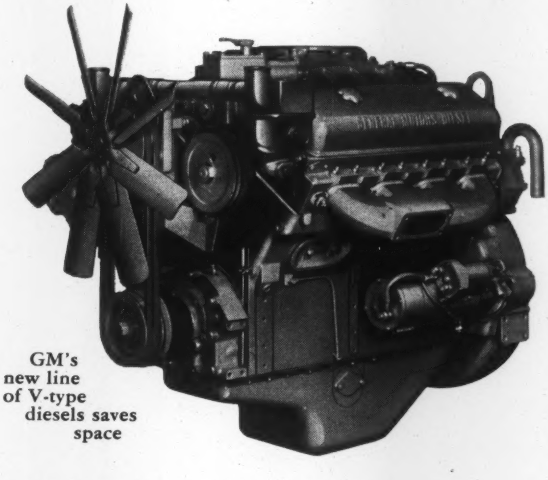
Precise checking of the lead of gears has required great skill and laborious procedures with gage blocks, micrometers, verniers, and gear trains. A new lead-measuring instrument, the 1218A Checker, developed by Michigan Tool Company, Detroit, does away with these complications and precision checks gear leads from zero to infinity. No special training is required to operate the unit and calculations are virtually eliminated. The sine-bar-controlled machine, although primarily designed for external and internal helical gears, and spur gears, also checks either right or left-hand leads on herringbones or worms. The checking instrument takes gears up to 18 in. in diam with shaft lengths to 24 in.

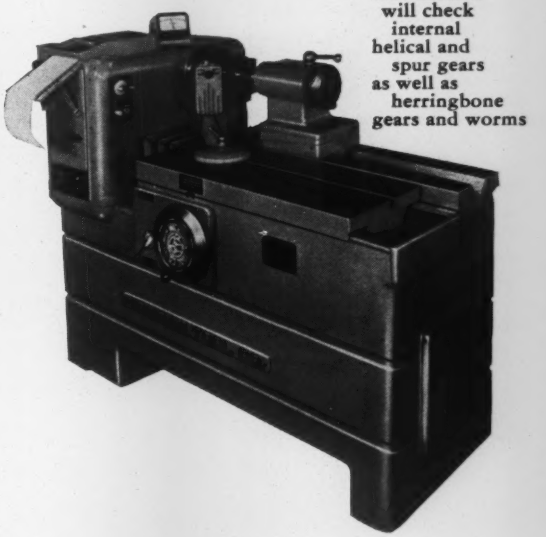
A built-in optical system is the basis of the new easy-setup method. A 56× microscope with graduated eyepiece, providing an unreversed right-side-up image, is built in over the sine-bar table. Exact angle location is a matter of aligning cross-hair markings on the scope's eyepiece with the precision-graduated sine-bar plate.

The scope and eyepiece divide a degree into 1000 parts. The sine-bar table is merely rotated manually from a handwheel and is worm-gear set. The sine-bar plate is positively locked in position without the slightest deviation from the correct scope setting.

Combined with the optical system is an electronic gage for recording errors in tooth profile of external and internal-spur and helical gears. This unit consists of a light-load gaging head and high-response amplifier connected to a calibrated meter to visibly indicate how far off lead the work may be in incremets of 0.0001 in.

Also included as part of the 1218A Lead Checker is an integral recording unit to provide a visual record of all checking data. The recorder is mounted convenient to the operator for ready reference. It records, in ink, on Michigan-supplied paper printed in increments of 0.0002 in. which can be interpolated to 0.0001 in.


GM's new line of V-type diesels saves space


Optical lead checker will check internal helical and spur gears as well as herringbone gears and worms

Magnetic Filter Bed

A MAGNETIC FILTER, in which the filter bed is a layer of ferromagnetic powder held midway in a column by means of a magnetic field generated across this area, is described in the quarterly review of *Reactor Fuel Processing* prepared for the Atomic Energy Commission by the Argonne National Laboratory. The item was prepared from an ORNL report by R. J. McNamee and L. B. Shappert.

The filter permits discharge of the filter cake and the reforming of a new cake remotely.

The field is produced by an electromagnet, the opposite pole pieces of which surround the column. The filter may be built up by introducing the powder to the column while the current to the magnet is on. As the powder falls down the column, it is caught and held by the resulting magnetic field. Additional structural support is given to the bed by a stainless-steel screen across the column. Filtration, using the powder as the filter bed, may then be carried out in a conventional manner, the feed entering at the top, and the resulting filtrate passing out the bottom. After the filtration, the old bed and filter cake may be discharged by simply turning off the current to the magnet and flushing the bed out the bottom with water or another liquid. This unit is more adaptable to an application where the filtrate is the product rather than the cake. The cake and bed can then be disposed of together without any subsequent separation.

100-Ton Vertical Stamping Press

A 100-TON press that stamps rotor laminations so fast that a production and handling upheaval will be required to keep up with it has been produced by Precision Welder and Flexopress Corporation, Cincinnati, Ohio, for a leading midwestern manufacturer of electric motors. The press produces these parts at rates exceeding 300 parts per minute—one for each press stroke and three times the rate for any previous press.

To accomplish this, the $^1/_2$-ton ram on Precision Flexopress must travel 2 in., come to a full stop, and reverse direction 600 times a minute. At such speed, the inertia of the ram creates an impact force of at least 100 tons.

Most presses operating with this speed and stroke would walk away and shake themselves to pieces. Flexopress doesn't even have to be bolted to the floor. Much of the secret of its operating smoothness lies in the preloaded ball-bearing raceways on the ram, a Flexopress patented exclusive.

The V-type raceways require no clearance for lubrication. The ram is "locked" to operate only in the vertical plane, preventing the side play inherent in plain slide presses. This no-float construction maintains positive alignment of punch and die.

Because of this precision, the press is expected to double the life of the blanking dies used in it in spite of the fact that the dies will blank slots and holes in 0.025-in. silicon-steel circles—and silicon steel is a brittle, die-busting material.

Flexopress is designed with six preloaded ballbearing gibs, two more than usual, to permit the press to be inclined if the user desires and still have the weight of the ram carried on four gibs instead of just the back two.

The press has also been equipped with a Precision-designed Fingerflex Feeder, a simple shuttle feed employing spring-loaded fingers in reciprocating and stationary guides to slide the blanks off a stack and into the die. It is linked by a timing chain with the crankshaft of the press.

If two blanks stick together and are fed into the die, the press is stopped by the Precision Flexostop before any damage can occur. It operates by detecting indicated deflection of the press flywheel caused by as little as 0.010-in. additional stock thickness, and immediately disengages the air clutch.

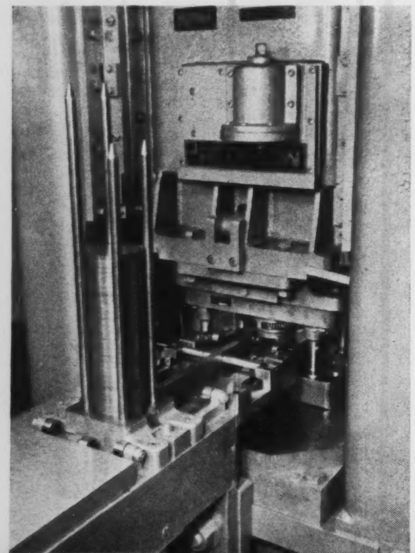
Precision engineers are now shooting for heavy press operation up to 1000 strokes a minute which they predict will be routine in a few years.

Hydro Progress in Canada

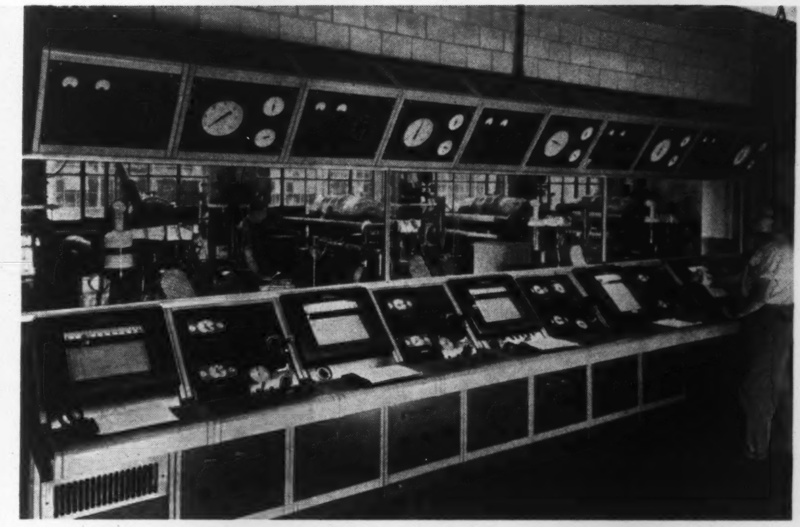
IN THE annual bulletin on Hydro-Electric Progress in Canada, issued by the Water Resources Branch of the Department of Northern Affairs and National Resources, it is reported that a new high was established in 1958 in the amount of new hydroelectric generating capacity brought into operation during a period of one year.

A net total of 2,485,040 hp of new capacity was installed after making allowance for the dismantling of

A stack of blanks which passes into the die area for blanking into laminations for electric motors will last only 2 min



In spite of a guaranteed operating speed of 250 strokes per min, the 100-ton Flexopress does not "walk" or vibrate



All equipment and five sets of controls and indicators are within easy reach and sight of a single operator in a unique diesel-engine test facility

6360 hp of existing capacity. The previous record year was 1954 during which 1,758,450 hp of new capacity was completed. Other installations under construction are expected to add about 2,000,000 hp of new capacity during 1959 and more than 2,600,000 hp over succeeding years.

Major installations during the year were made at the Robert H. Saunders-St. Lawrence Generating Station where nine units totaling 675,000 hp were placed in operation, and at the Bersimis I development of the Quebec Hydro-Electric Commission where the final three units totaling 450,000 hp were installed. A number of sites, with large potential, are under investigation.

The total installed capacity of water-power plants in Canada is now listed at 22,376,048 hp, which is about one quarter of the feasible turbine installations based on the country's estimated water-power resources.

Ontario's total of 1,301,800 hp of new capacity installed during 1958 was the highest among the provinces. In addition, new capacity under construction is expected to add over 600,000 hp during 1959 and about 360,000 hp over succeeding years.

In the Province of Quebec, the installation of hydroelectric facilities accelerated during 1958 when new capacity totaling 900,000 hp was brought into operation. In addition, new capacity currently under construction will add about 1,300,000 hp during 1959 and more than 1,400,000 in later years.

Diesel-Engine Test Facility

A NEW diesel-engine test facility at Socony Mobil Oil Company's Paulsboro, N. J., research and development laboratory employs a novel, building-block modular control console to modernize and integrate four previously separate operations at one location and under control of a single technician.

Cost of the 20-ft-long console was held to a minimum by the selection of standard modular enclosures, panels, and components made by Elgin Metalformers Corporation of Elgin, Ill.

Human-engineering features of the Emcor modular design bring all equipment and controls within easy reach and sight of the control operator. Control of all five engines by identical equipment eliminates much of the complexity of a previous arrangement where control equipment and instrumentation were different for each engine. Technical procedural details which were overlooked occasionally in the former setup now are included automatically in the test assignments. Several engine tests can now be handled concurrently simply by moving just a few steps to the left or right.

A counterheight unit topped by a work-writing desk has sloped front turrets along its entire length which house most of the controls. It was designed with a low silhouette to provide the operator with a full view of the five engines through a large glass window.

Each of the five panels in the console includes a hydraulic throttle actuator, rheostat load controller, pneumatic shut-off valves, pneumatic temperature controllers, and electrical starting switches and timers. A recording potentiometer provides a record of engine temperatures and variables for review and comparison of results, and serves as a record of approval runs.

Speed tachometers, load gages, engine and exhaust-pressure indicators, ammeters, and voltmeters are mounted in ten inverted turrets which slope downward for maximum visual convenience.

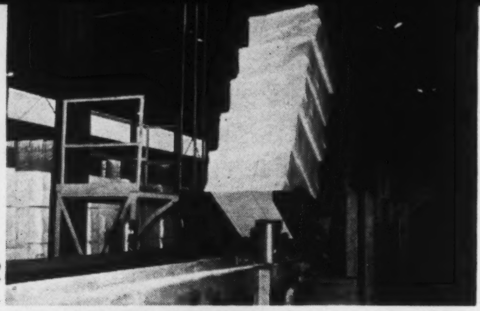
River Rouge Sets Record

A NEW HIGH in capacity for electrical output from a single steam-electric unit was reached recently by Unit No. 3 of the River Rouge Plant of the Detroit Edison Company. (ASME Paper No. 58—SA-22 describing this unit will appear in the new ASME Transactions quarterly, *Journal of Engineering for Power*.) The turbine generator produced electricity at a rate in excess of 340,000 kw for approximately 24 hr while supplied with 2,300,000 lb per hr of steam from a single Foster Wheeler natural-circulation steam generator.

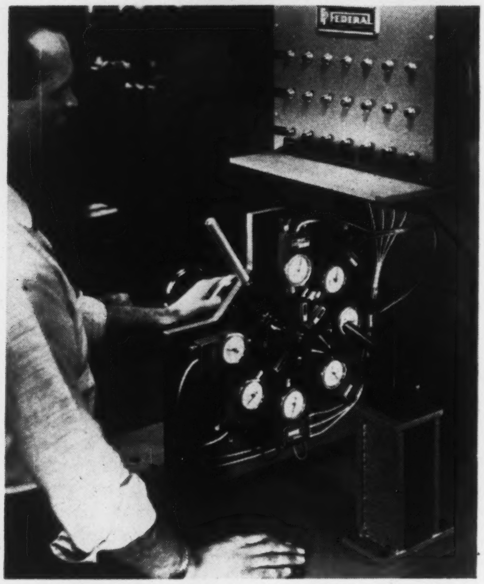
All major equipment exceeded design capacities. The Foster Wheeler steam generator which was designed for 2,000,000 lb per hr at 2725 psi and 1050/1000 F exceeded this by 300,000 lb per hr. The Allis-Chalmers turbine which carries a name-plate rating of 320,000 kw developed 341,000 kw. The heat rate of Unit No. 3 is 8620 Btu per kwhr.

The double-furnace steam generator is fired by pulverized bituminous coal and will produce 1 kwhr of electricity from less than $^3/_4$ lb of coal. The unit's efficiency is over 90 per cent.

PHOTO BRIEFS



2



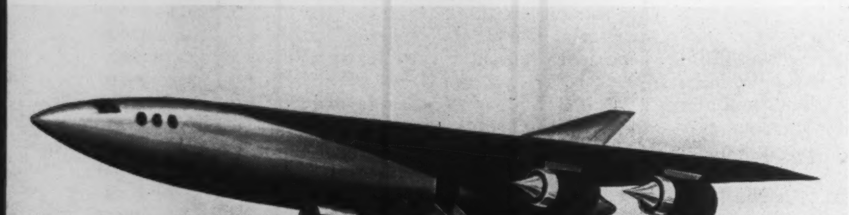
3

2 Automatic Stacker. Two upenders are used in tandem to upend loads singly at first and then in groups of five for delivery to a conveyer or an industrial truck. Loads too soft or irregular for clamps are easily handled. Device is manufactured by Lamson Corporation, Syracuse, N. Y.

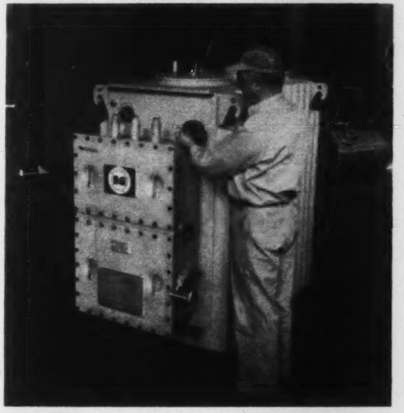
3 Seven Cams Checked Simultaneously. Contour, proper stacking, and broken edges can be checked on groups of seven different cams with a semiautomatic gage manufactured by Federal Products Corporation, Providence, R. I. Gaging contacts which check the workpieces are referenced by pantographs to similar contacts on the cams in the master stack. Lights indicate whether each cam is okay, under, or over.

1 Coast to Coast in 1 Hour. Ramjet-powered 100-passenger transports flying coast to coast in 1 hour have been demonstrated to be practical according to Roy E. Marquardt, president of Marquardt Aircraft Company, Van Nuys, Calif., and Mem. ASME. Planes would cruise at Mach 4 at 80,000 ft.

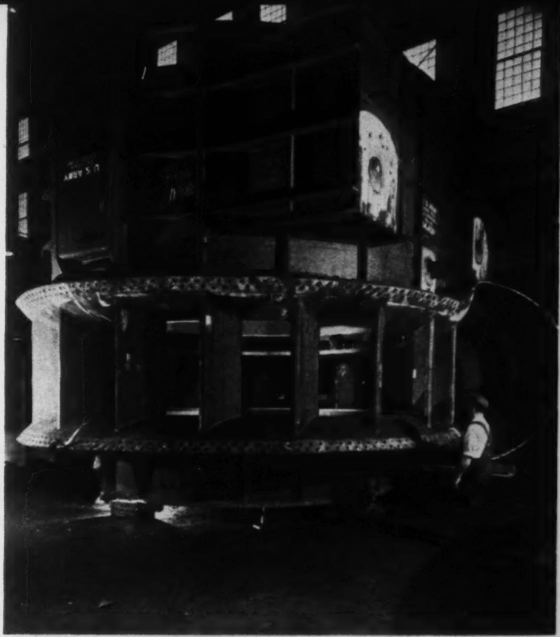
1

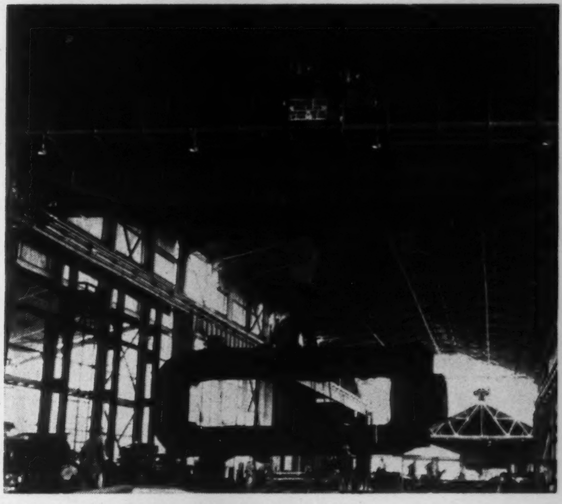

HYPOTHETICAL HIGH MACH NO. RAMJET TRANSPORT

4

5


6

7


8


4 Heating, Cooling, and Light—in One Panel. The thermoelectric effect is utilized to provide 55 to 120-F in irregular metal shapes to heat or cool a room. Phosphor coating sandwiched in a panel no thicker than a pane of window glass is a-c excited to provide a variety of color combinations and light intensities. There are no moving parts in this 4 × 6-ft panel made by Westinghouse. A thermostat provides temperature control.

5 Aluminum Network-Transformer Tank. In industrial, seacoast, or other corrosive environments where network transformers are used, Alcoa 6061 aluminum-alloy tanks last longer and require less maintenance. Prototypes of both network and power aluminum transformers have been made by Moloney Electric Company and Alcoa.

6 Turbine-Blade Design Speeded. A 3-dimensional analog computer helps Westinghouse engineers design and verify new turbine blades in about one third the previous time.

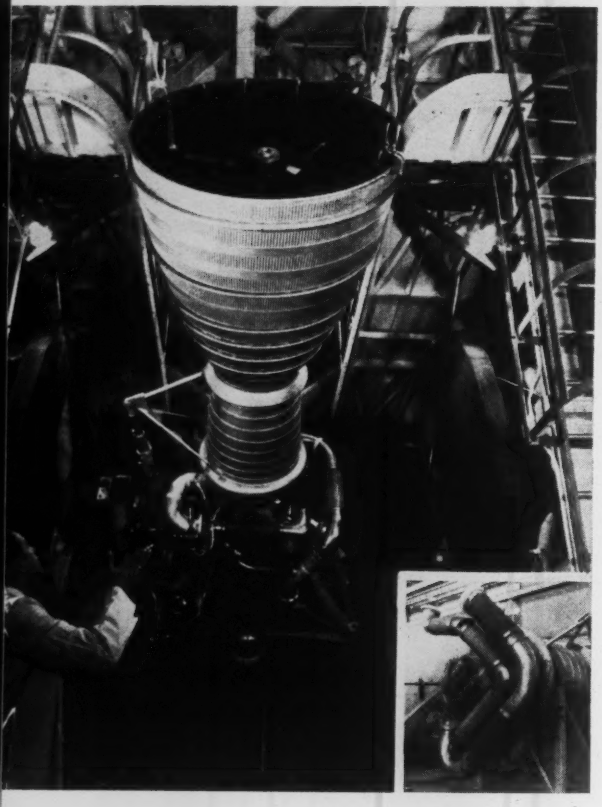
7 Hydraulic Turbines for Fort Peck Dam. Discharge ring, stay ring, and pit liner for one of two 63,500-hp, 128.6-rpm, 170-ft-head Allis-Chalmers Francis runner, plate-steel scroll-case hydraulic turbines. These 22-ft-diam, 18-ft-over-all-height assemblies will be installed at Fort Peck Dam, Mont.

8 Overhead Aluminum Crane. A 150-ton-rated-capacity overhead aluminum crane which weighs 50 tons less than an equivalent-strength steel crane lifts a 200-ton housing at Reynolds Metals Company Alloys Plant near Sheffield, Ala., with only a fraction of an inch momentary deflection. Fourteen aluminum overhead cranes are in use at the new plant.

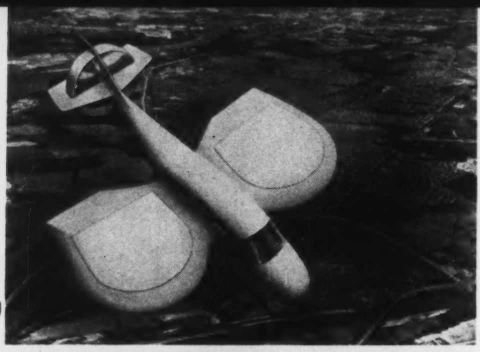
PHOTO BRIEFS

9 Ducts for Wide Temperature Range. Liquid oxygen is carried from the pump to the thrust chamber of missiles under development at Rocketdyne, a division of North American Aviation, Inc., in massive ducts with flex joints. The A-286 alloy used is made by Allegheny Ludlum Steel Corporation. A lightweight, high-temperature, corrosion-resistant alloy, it is unusually strong at low temperatures as well, and encounters a range from —297 F to a plus of several hundred F in this use.

9



10



11

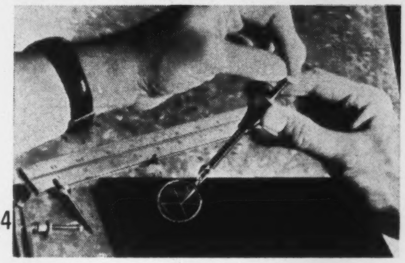
10 Vertical-Lift Aircraft. Shrouded propellers in each wing provide vertical lift during take-off, and large closures convert the wings to high-lift surfaces during forward flight in an aircraft designed to provide the economy and speed of fixed-wing planes with the versatility of the helicopter. The prototype nearing completion by Vanguard Air and Marine Corporation, Radnor, Pa., is 24 ft long and has a 22-ft wingspread.

11 Creep-Strain Test Monitor. A solenoid timer can be set for readings at any interval between 64 frames per sec and 1 frame every 10 hr with an automatic creep-strain monitor at the Martin Company's Baltimore, Md., materials-engineering laboratory. The furnace at upper right is swung aside to disclose the test specimen to which a small slide-rule-type platinum gage has been clamped. Specimen and gage are magnified by a microscope. Time and temperature information are fed into the film record by an imposition device.

12

13

14



12 **Powder-Metallurgy Use in Autos.** About 15 lb of powder-metallurgy parts are going into the average passenger car built this year, according to the Metal Powder Industries Federation, New York, N. Y. An 0.81-lb iron-powder transmission-oil-pump rotor being automatically ejected from the die table of a 200-ton compacting press at Ford Motor Company illustrates trend to larger structural p-m parts.

13 **Chatterless Height Check.** Chatter and other vibration are eliminated with Brown & Sharpe's new Hite-Cheks. Lightweight, aluminum tapered-box-construction uprights provide rigidity and stability in supporting any dial test indicator in any position. Sturdy bases with hardened and lapped graphitic-steel wear pads provide smooth, easy movement. Two-piece sliding heads permit quick rough settings, while positive fine adjustments can be securely clamped.

14 **Center Scriber.** Center punching is facilitated by the Centa-Scribe, designed and produced by the Langley Corporation, San Diego, Calif. Centers of measurement are laid out with higher accuracy since a magnifier clearly shows hundredths scale graduations. For rapid center punching, the Centa-Scribe is assembled with hammer raised. The center to be used is located and the hammer dropped from the top of the handle, providing an accurately located center for further enlarging or drilling. A carbide-point scriber is easily attached.

15

16

15 **Iron-Ore Facility.** A $15-million Burnside Bulk Marine Terminal and an adjacent $55-million Ormet Corporation alumina plant have been completed at Burnside, La. The terminal, largest facility for handling bulk cargo in the Gulf Coast area, has two gantry-crane unloaders, each having a lifting capacity of 12 tons, a free digging capacity of 1200 tons per hr, and a 148-cu-ft-capacity ore bucket. The conveyer moves ore to the barge loader which operates at up to 1500 tons per hr.

16 **Missile-Component Tester.** Preliminary checks of maximum and minimum component tolerances, combined-component checks, and final stand tests are made on a missile target seeker with a complete system of automatic and semiautomatic test stands developed by Westinghouse.

Engineering
Progress in the
British Isles and
Western Europe

J. FOSTER PETREE
European
Correspondent

EUROPEAN SURVEY

British Uranium Fuel-Element Plant

The process of declassification in the activities of the United Kingdom Atomic Energy Authority has now extended to the plant at Springfields, Lancashire, England, which produces the rods of metallic uranium used as fuel elements in the Authority's reactors at the Calder Hall and Chapelcross nuclear power stations and for experimental work at their research station at Harwell. The plant is situated on the main road between Preston and Blackpool and covers about 218 acres, within which there are $6^1/_2$ miles of roads and $7^1/_2$ miles of railroad tracks. About 2750 persons are employed there.

Originally the plant was designed to use pitchblende as its raw material, but it now operates on "concentrate," i.e., crude uranium oxide, thus cutting out the preliminary stage of precipitation with hydrogen peroxide. The concentrate is delivered in drums, which are emptied into a hopper whence it is fed by screw conveyer to the dissolvers; these are stainless-steel tanks fitted with steam heating coils and stirrers, and in them the concentrate is dissolved in nitric acid. After cooling, the solution is fed to rotary filters, large rotating horizontal drums of fine mesh. A vacuum is maintained inside the drum. As the lower part of the drum dips into the solution of uranyl nitrate, solid impurities are collected on the surface of the mesh and are scraped off for reprocessing to remove all traces of uranium. The solution sucked through the mesh is purified by solvent extraction with a solution of tributyl phosphate in odorless kerosene, in mixer-settler units arranged in a cascade. In these the liquids separate in layers, being of different densities, the uranyl nitrate collecting in the solvent phase and the impurities in the aqueous phase. The solvent phase flows upward to the next mixer section and the aqueous phase flows downward, so that the uranyl nitrate is almost completely removed from the aqueous phase. Eventually the tributyl phosphate emerges with the uranyl nitrate in solution and passes through a heating unit, the uranyl nitrate being then washed out of the solvent by a weak solution of nitric acid.

The uranyl nitrate is next treated with ammonia to precipitate the uranium as ammonium diuranate, which is run off through Nutsch filters, on which the diuranate collects as a thick paste. This is loaded into trays which are heated in an electric furnace, decomposing the diuranate and leaving uranium trioxide on the trays. Hydrogen is passed through, reducing the trioxide to dioxide, and is followed by anhydrous hydrofluoric acid, which converts the dioxide to uranium tetrafluoride. This is mixed with magnesium turnings in an automatic weighing and mixing machine, pelleted in an automatic press, and transferred by conveyer to another section, where the pellets are charged into furnace reactors.

The pellets are packed into steel cylinders having a graphite lining, which, when filled, are placed in an electric furnace, in which the reduction reaction takes place. After cooling, the uranium is removed in the form of a billet of the metal.

The billets are cleaned, sampled, and sent to store, from which they are withdrawn as required by the casting section, which melts the metal in vacuum furnaces heated by high-frequency induction and casts it into cylindrical molds. The cast rods are machined, with intermediate heat-treatments, inspected, carefully checked for dimensional accuracy, and are then ready for assembly into fuel elements by inserting them in the "cans." Formerly the can material was aluminum, but this was not able to withstand the operating temperature of the Calder Hall reactors and so has been superseded by a magnesium alloy known as Magnox. The cans are open-ended finned tubes as received at Springfields. They are degreased with trichlorethylene and a cup is then inserted in one end and automatically welded in position in an inert atmosphere of argon. The uranium bar is then inserted, the other end is closed similarly with a welded cap, and the completed can is pressurized in an autoclave to squeeze the metal of the can firmly onto the rod to insure good metallic contact.

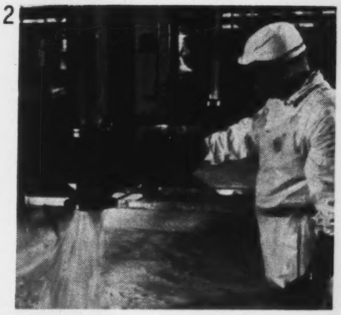
To avoid any contamination of the surface of the can by particles of uranium, the cans and the bars are not allowed to be in the same room; the open end of the can is entered into a hole in the wall, and the bar is fed into it from the adjoining compartment.

Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

Uranium Fuel-Element Plant

1 Crude uranium oxide in sealed drums
2 Ammonium diuranate being poured into Nutsch filters
3 Uranyl nitrate solution circulates in storage tanks to prevent settling
4 Furnaces *in foreground* heat mixtures of magnesium and uranium tetrafluoride. *In background,* reactor is removed from cooling bay to extract billet.
5 Mold for uranium fuel rods is placed into vacuum casting furnace
6 Cast rods of uranium stored temporarily
7 Beta quench apparatus. Uranium rod is removed after receiving heat-treatment to reduce grain size of uranium metal.
8 Uranium rod after casting and heat treatment is machined to accepted tolerances in "Centerless Bar Turner"
9 Complete fuel element receives final cleaning before packing
10 Cast rod is inserted in "can" for assembly into fuel elements

1

2


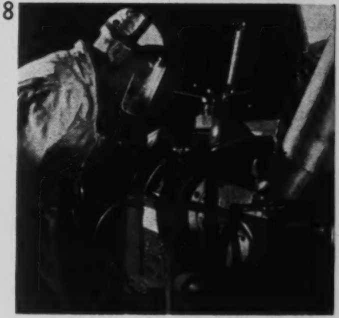
3

4

5

6

7

8


9

10

Giant Excavator for Brown Coal

THE largest bucket-wheel excavator yet constructed has been put to work recently in the German open-cast lignite workings in the neighborhood of Cologne. Built by the Fried. Krupp Maschinenund Stahlbau, of Rheinhausen, it weighs 5550 long tons and can excavate 11,100 cu yd per hour. The bucketwheel is 59 ft in diam and is carried at the end of a boom 212 ft long; it has 11 buckets, each of $5^1/_4$ cu yd capacity and is driven by three d-c motors of 500 hp each. It will cut on a face 164 ft high, from 20 ft below the ground level on which the excavator stands to 144 ft above it. The weight of the boom, the bucket wheel, and the belt conveyer within the boom, onto which the buckets discharge, together with the downward reaction of the cutting force, are balanced by a cantilever boom, carrying a counterweight, which projects to the rear of the central tower. The tower with its booms is rotatable on the base structure, and the weight of the whole is carried on 12 crawler tracks, disposed in groups of four. Two of these groups move only in a straight line, forward or backward; in plan, these form, as it were, the base of a triangle, the apex of which is the third group of four tracks, which can rotate on its vertical axis so as to rotate the whole structure, this movement being assisted by driving forward on one of the nonrotating groups of tracks and backward on the other.

Connected to the excavator by a lattice bridge is a loading station for rail cars. This also is mounted on crawler tracks, three in number, and to some extent can move independently of the excavator, its connection to the main bridge being through a smaller linking bridge, one end of which is rotatable about its support on the top of the loading station while the other end slides along the underside of the main bridge. Each bridge carries its own belt conveyer, one discharging to another until the excavated material, coal or overburden, reaches the hoppers of the loading station, from which it is discharged by gravity into the dump cars.

In this particular mine, the North Fortuna, the bed of brown coal is about 30 to 35 ft thick and lies under about 100 ft of overburden. The excavator was erected on level ground outside the mine and then crawled down into it, cutting its own road to do so and crossing a nearby public road in the process. It was able to do this without difficulty as, in spite of its great weight, the unit pressure on the steel-plate tracks is only about 1.25 kg per sq cm (about 250 lb/sq ft). Electric drive is used throughout, the a-c supply being received through a trailing cable, coiled on a transportable drum. Where direct current is required, it is transformed on the excavator. There are in all 174 electric motors, and the total electrical load is some 14,300 kw. There is an extensive system of loudspeakers, in addition to warning hooters, to give notice of intended movements, etc., and wired television is also provided to enable the operators to supervise areas outside their field of direct vision.

American Stokers for British Railways

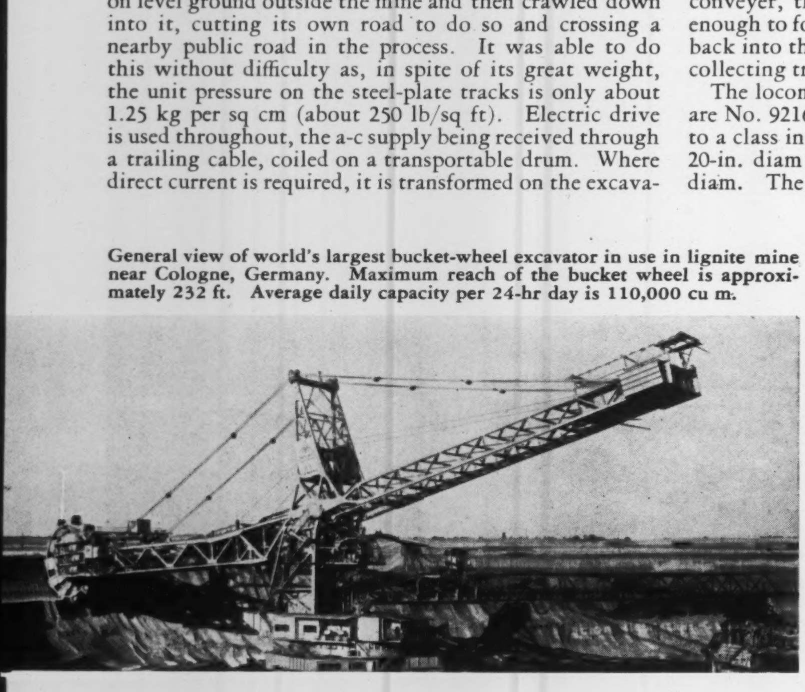
BY AMERICAN standards, British railway locomotives are not large and for most of them hand-firing is adequate, but the heaviest types for long-distance passenger trains and for the haulage of ore and coal traffic are big enough to tax even the best fireman. Recently, therefore, British Railways have been reconsidering the use of mechanical stokers as a means of getting the maximum output and, as an experiment, have fitted three new 2-10-0 freight locomotives with Berkley stokers.

These have been supplied by the Berkley Stoker Company, Ltd., Grand Buildings, Trafalgar Square, London, W.C.2, the British associated company of the Berkley Machine Works and Foundry Company, Inc., of Norfolk, Va., who developed this type of stoker. It comprises a screw conveyer, in three sections, which is driven by a two-cylinder steam engine mounted on the tender and feeds the coal onto a distributor plate located below the firehole, whence it is blown into the firebox by steam jets situated beneath the distributor.

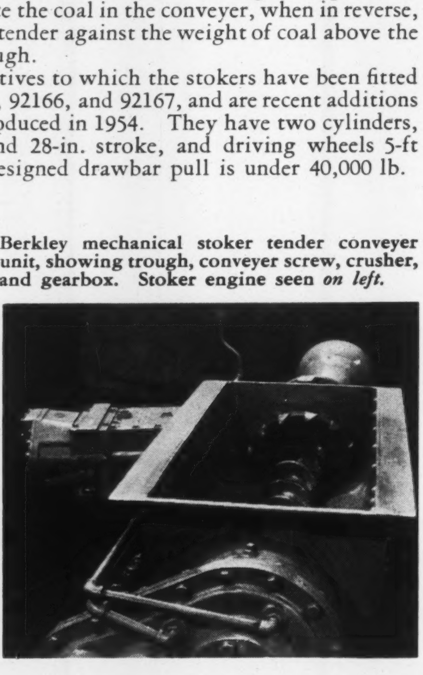
The power unit is mounted on the tender, with the first section of the conveyer. The conveyer screw is in three parts, connected by universal joints, and the intermediate section of the casing containing it has a ball joint connection to the third or riser section, which extends upward through the footplate and is secured to the front of the firebox. The steam nozzles are arranged in four groups, each with a separate steam control valve, so that the power of the jets can be regulated as desired to spread the coal over the firebed. The stoker engine takes steam at the full working pressure of 250 psig and is reversible if necessary, to clear jams in the conveyer casings; though, as a crusher is built into the tender section of the conveyer, these seldom occur. The engine is powerful enough to force the coal in the conveyer, when in reverse, back into the tender against the weight of coal above the collecting trough.

The locomotives to which the stokers have been fitted are No. 92165, 92166, and 92167, and are recent additions to a class introduced in 1954. They have two cylinders, 20-in. diam and 28-in. stroke, and driving wheels 5-ft diam. The designed drawbar pull is under 40,000 lb.

General view of world's largest bucket-wheel excavator in use in lignite mine near Cologne, Germany. Maximum reach of the bucket wheel is approximately 232 ft. Average daily capacity per 24-hr day is 110,000 cu m.



Berkley mechanical stoker tender conveyer unit, showing trough, conveyer screw, crusher, and gearbox. Stoker engine seen *on left.*



Substance in
Brief of Papers
Presented at
ASME Meetings

M. ZANFARDINO
Staff Editor

ASME TECHNICAL DIGEST

Lubrication

Optimum Methods for Oil-Jet Lubricating Jet-Engine Main-Shaft Ball Bearings.........58—A-258

By R. E. Murteza, Assoc. Mem. ASME, General Motors Corporation, Bristol, Conn. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

A study of how oil-jet lubricating techniques will improve performance is presented.

Variations in oil-jet lubricating techniques were studied under controlled conditions in a 110-mm-bore main-shaft bearing test rig. Separators were two-piece machined iron-silicon bronze which were inner or outer-ring controlled (guided, land riding). Test bearings were oil-jet lubricated with MIL-L-7808 (diester at 100 F inlet-oil temperature) from three equally spaced oil jets at approximately one, five, and nine o'clock positions. Oil jet was introduced at 27 ppm. Bearings were operated at 6000 inner ring rpm, constant 3000 lb radial load, and varying thrust load from 1500 to 7500 lb.

Values of torque, inner and outer-ring temperatures, and the quantity of transmitted oil were recorded for each successive thrust load after a 20-min stabilization period.

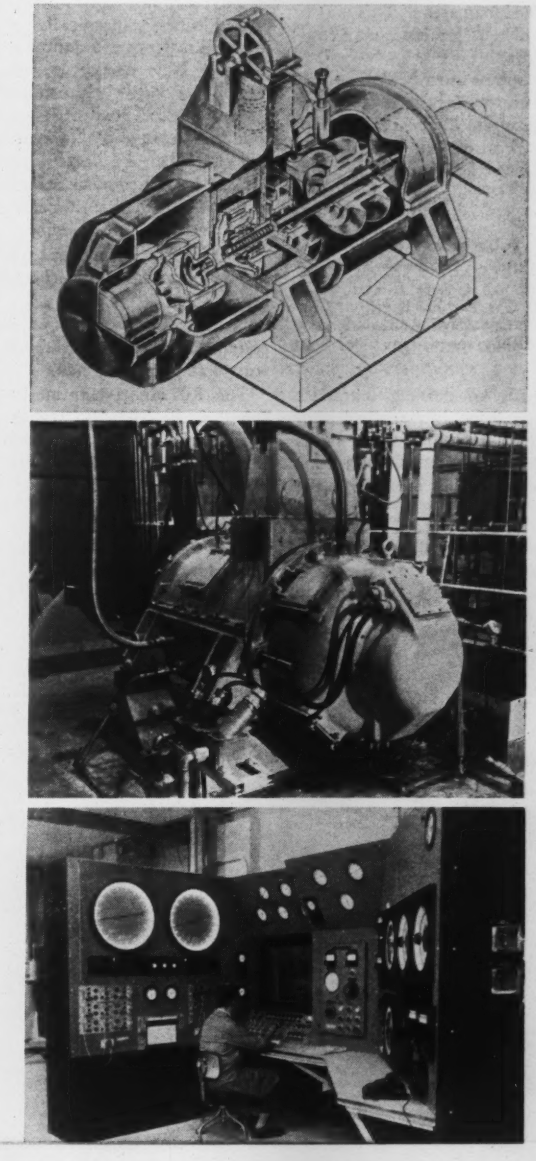
Recorded outer-ring temperatures were averaged from three equally spaced thermocouples around the periphery of the bearing ring. At least five points were used to plot any of the recorded variables.

Tests were conducted with outer-ring-controlled separators to: Determine the effect of introducing lubricant in the opposite or same direction as applied thrust load on the inner ring; and compare the results obtained by directing the lubricant toward the separator pilot or nonpiloting areas.

The separator piloting area is the small circumferential area between the bearing outer ring ID and separator ID. Separator nonpiloting area is the larger circumferential area between the bearing inner ring OD and separator ID.

Also studied was the effect of reduced

Full-scale main-shaft bearing test rig constructed to permit rapid controlled testing under wide range of variables experienced by jet engine bearings. Rig is capable of testing 110 to 140-mm-bore single or duplex-ball or roller bearings at speeds from 1000 to 20,000 rpm, can be subjected to loads up to 75,000-lb thrust, 25,000 radial, and 8000-lb reverse thrust. Seen here, *top to bottom*, cutaway view, side view, and control console. (58—A-258)



oil flow on bearing operating performance with oil jets directed into separator nonpiloting area. Included in tests of outer-ring-controlled separators were studies of effect of quantity of oil flow on bearing operating characteristics and effect of number and circumferential location of oil nozzles on bearing torque and temperature.

Tests with inner-ring-controlled separators were similarly performed.

It was found that:

1 Bearings having inner or outer-ring-controlled separators are best lubricated by directing oil jets in the direction opposed to the direction of applied thrust load on the inner ring.

2 Outer-ring and inner-ring-controlled separators are best lubricated by directing oil jets into the separator nonpiloting and pilot areas, respectively.

3 Outer-ring-controlled separators operating under combined loads require that at least one oil nozzle be directed into the combined load area. This is also thought to hold true for inner-ring-controlled separators.

4 The selection of inner or outer-ring-controlled separators appears to be a compromise between lower torque and outer-ring temperature for the former and lower oil flow and inner-ring temperature for the latter.

Experimental Laboratory Studies of Bearing Fatigue.....58—A-235

By R. A. Baughman, General Electric Company, Aircraft Gas Turbine Division, Cincinnati, Ohio. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Fatigue testing of bearing materials is one of the most difficult tests to perform in the laboratory. The difficulty stems from two quite different sources, one being the metallurgical nature of the materials involved, including extremely high hardness, high strength, general notch sensitivity, and low-impact characteristics; and the other, the relative difficulty of proving the significance of laboratory test results as related to bearing applications.

A program of investigation was undertaken in January, 1957, to develop a technique of obtaining laboratory bearing fatigue data and to attempt correlation with bearing tests which were being made in conjunction with a bearing development program.

The result of this work has been the development of the RC rig, a new laboratory tool for study of bearing fatigue. This machine is a Krouse rotating-beam fatigue machine which has been modified by removal of the cantilever stressing mechanism and addition of pendulum-supported rollers. A cold-rolled-steel fabricated frame bolted securely to the Krouse unit supports the massive steel yokes through press-fitted hardened pinned joints. Specifically, ground bearing steel rollers are mounted in each yoke using a New Departure double-shield bearing no. 55610. The unit also utilizes a stainless-steel load cell, prepared with four SR4 strain gages for load application and control.

Load is applied mechanically by means of a fine-threaded turnbuckle which can be adjusted for any severity.

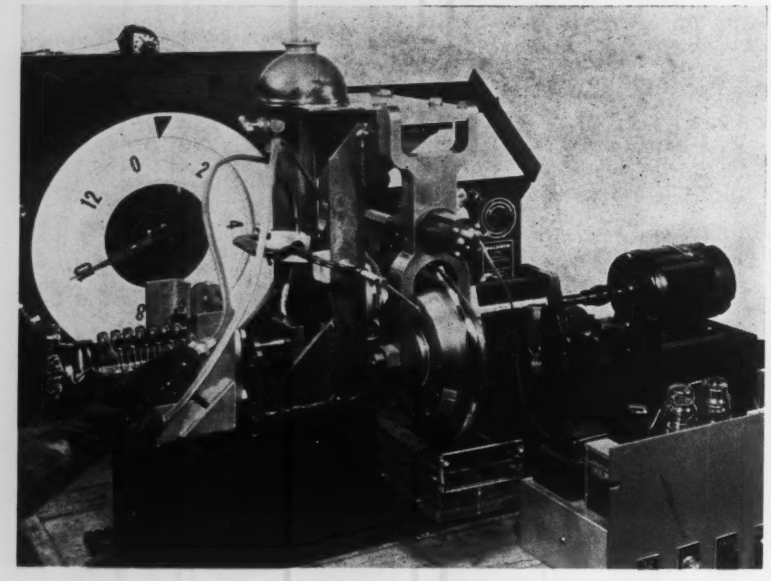
Lubrication is provided for by mounting a container above the test contact area.

Bearing stress results from intimate contact between the pendulum-supported rollers and the specimen.

The RC rig testing method has been found to be useful in studies of fatigue of bearing materials at room and elevated temperatures. The data obtained have a striking resemblance to actual bearing fatigue data and can be useful in making correlations between laboratory studies and actual bearing application.

A Weibull fatigue map has been prepared on MV-1 tool steel (Rc 64) operating at room temperature with Mil-L-7808 lubricant. Also, the effect of three lubricants on fatigue life of M-1 tool steel has been shown. The importance of lubricant viscosity is indicated.

RC rig, high-temperature model for study of bearing fatigue (58—A-235)



The Mechanics of Rolling-Element Bearing Vibrations.....58—A-292

By Tibor Tallian and Olof Gustafsson, SKF Industries, Inc., Philadelphia, Pa. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Vibration of rolling bearings generated by geometrical imperfections of the rolled-over surfaces is investigated. Surface imperfections along the paths of rolling are described by Fourier series. Vibration transfer characteristics of the bearing as functions of frequency and ball complement position are introduced. Vibration output at a point of the free outer-ring OD is computed. The random nature of the surface imperfections and of the vibration is considered. Experimental determination of transfer characteristics is briefly discussed. After some numerical examples, the case of the bearing coupled to "burdens" of damped masses and compliances is outlined.

Some Instabilities and Operating Characteristics of High-Speed Gas-Lubricated Journal Bearings.............................58—A-231

By G. K. Fischer, Assoc. Mem. ASME, and J. L. Cherubim, Assoc. Mem. ASME, Stratos, Division of Fairchild Engine and Aircraft Corporation, Bay Shore, N. Y.; and D. D. Fuller, Mem. ASME, Columbia University, New York, N. Y. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

In order to take advantage of the low friction, cleanliness, and excellent high-temperature properties of gas-lubricated bearings, it was necessary to know more about their instabilities.

To measure these instabilities, a system of instrumentation was needed having sufficient accuracy, response, range, stability, and resolution.

The system used was developed for the measurement of the growth of small rotating cylinders due to centrifugal forces. It measured the dynamic position of the journal to within five per cent of the diametral clearance. The system was composed of a Fielden proximity meter which measured minute static and dynamic changes at a probe. The probe was one plate of a condenser and the journal was the other. The proximity meter has a sensitivity of 0.001 micro-micro-farads and a frequency response that is flat up to 1200 cps.

Various factors influencing the stable operation of high-speed rotors on gas-lubricated journal bearings have been isolated such as critical speed, unbalance, film stiffness, whirl, damping, and air hammer. Experimental data are given for a number of bearings to illustrate the effects of these factors on operation of gas-lubricated bearings and correlation to mathematical analysis. The isolation and understanding of these factors have been due primarily to the instrumentation developed. Rotor assemblies on $^1/_2$ and $^3/_4$-in-diam shafts have been run successfully on hydrostatic and hydrodynamic air bearings at speeds up to 165,000 rpm.

Performance Characteristics of Lubricating Oil Film Between Disks ....58—A-254

By S. I. El-Sisi, Assuit University, Assuit, Egypt; and G. S. A. Shawki, Cairo University, Cairo, Egypt. 1958 ASME Annual Meeting paper (multilithographed; to be published in Trans. ASME—*J. Basic Engng.*; available to Oct. 1, 1959).

The formation of hydrodynamic lubricating films between gear teeth presents a most interesting and rather complicated problem from both theoretical and experimental viewpoints.

On the theoretical side, the main difficulties seem to include the variation of lubricant viscosity with film temperature and pressure, the effect of surface roughness and deformation under load, the mechanism of film formation, and the extent of operative film between mating surfaces.

Development of satisfactory apparatus for investigating the performance of lubricating film between gear teeth presents certain practical difficulties. It is evident that the use of actual gears is hampered by the high cost incurred in the production of highly accurate gear profiles. Moreover, measurements in the vicinity of tooth contact are not easy to make.

These drawbacks led to the development of testing machines in which cylindrical disks are used to simulate gear teeth action kinematically. This idealization greatly simplifies relevant investigations.

Little attention has yet been devoted to the problem of fluid-film formation between mating gear surfaces, a fact which aroused considerable interest in planning and carrying out a quantitative and systematic investigation of the relatively simple case of hydrodynamically lubricated cylindrical disks in an endeavor to determine the performance of lubricating films between continuously meshing gear teeth.

The present paper is concerned with the design and development of a testing machine with two independently driven disks which can be made to run under conditions of combined rolling and sliding in line or point contact, fluid-film thickness being measured by the electrical conductivity method.

Performance characteristics of the lubricating film between specimen disks (minimum film thickness and friction) are obtained (*a*) at and near pure rolling of disks and (*b*) at and near pure sliding with surfaces of the disks in line contact.

Test results show that the ratio of sliding to rolling velocity is a prime factor in the behavior of rotating disks. Values of this ratio equal to zero and unity (conditions of pure rolling and pure sliding, respectively) give rise to critical changes in the performance of the disks, being most favorable, from a lubrication viewpoint, at pure rolling (at the gear pitch-line), and least favorable at pure sliding where scuffing of surfaces may well be expected. Recent theoretical investigations do not seem to be able yet to account for salient results obtained in the present study. Further work on the subject is proceeding.

A Radiotracer Counting Method for Engine Wear Determination.... ....58—A-247

By E. H. Okrent and G. A. Weisgerber, Esso Research and Engineering Company, Linden, N. J. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Wear in automotive equipment is of prime importance to both the designer and lubricant formulator. Radiotracer techniques have increased the possibility of studying the mechanism of wear. The application of radioisotopes to engine tests has resulted in suitable short-duration tests which can predict lubricant performance. This has made possible research projects which would have been impossible in the past because of the extended test duration required to obtain measurable wear. Engine-wear studies, using irradiated engine parts, have been conducted to determine the effect of lubricant composition on piston-ring wear, gear wear, bearing wear, and valve train wear. Unlike the conventional extended engine tests, the radiotracer test methods do not require that engine components be removed from the engine and measured to determine wear. Thus new engine parts are not used for each subsequent test. As a result, surface condition and history of tests may affect test results unless adequate precautions are taken to eliminate them. The accuracy of the radiotracer tests depend for their wear measurements on the quantitative determination of the amount of wear debris in the used lubricant by counting with suitable equipment.

The methods available for detection and counting of radioactive debris are varied, each with its own advantage and disadvantage. Unfortunately, the selection and settings of the counting equipment are the most important factors in any radiotracer wear study, since they will determine the quality of the results and the success of the test program. An examination of the literature connected with radiotracer wear studies indicates a need for additional attention to counting methods and an understanding of the physics of the interactions of gamma rays and beta particles with matter.

This paper presents a technique for determining engine wear using irradiated engine parts and discusses in detail the physics of the counting system and the used oil matrix. A complete understanding of the physics of the counting system is required in order to avoid introducing errors which could invalidate the results. This paper includes two major topics—a discussion of counting techniques, followed by the application of these techniques to a determination of hardenable cast-iron valve-train wear rates of some commercial lubricants. Hardenable cast-iron valve-train wear was selected as the example for the counting discussion since refinement of counting techniques was required in order to measure this wear reproducibly.

In using radiotracer techniques to study engine wear, several sources of counting error exist: Instrument inadequacy, improper instrument settings, trace radioactive impurities, and Compton scattering. These may be overcome most reliably in valve-train wear studies by using a scintillation spectrometer adjusted for narrow-window differential counting at a primary photopeak which is affected least by impurities and scattering. The energy distribution (spectrum of both sample and standard) should be examined to insure validity of measurements. For valve lifters, the 1.1-mev photopeak of Fe^{59} is preferred.

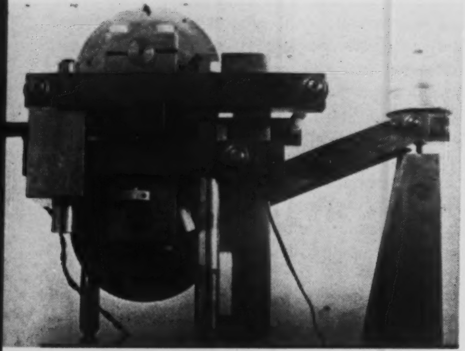
The radioactive test procedure permits one to obtain a wear versus time picture for each test run. This information not only characterizes the test oil, but also allows one to insure that errors due to improper surface condition or history are minimized.

The data presented show that radiotracer-lifter wear studies can predict field performance of lubricants in noncatastrophic wear, provided care is taken to eliminate the problems previously discussed.

Measurement of Oil-Film Thickness Between Disks by Electrical Conductivity..............58—A-253

By S. I. El-Sisi, Assuit University, Assuit, Egypt; and G. S. A. Shawki, Cairo University, Cairo, Egypt. 1958 ASME Annual Meeting paper (multilithographed; to be published in Trans. ASME—*J. Basic Engng.*; available to Oct. 1, 1959).

Accurate measurement of thin oil film has handicapped quantitative investigation on performance of lubricating oil films formed between gear teeth. Other investigators have tried the method of electrical conductivity and it has been reported that the interpretation of electrical resistance in terms of film thickness is not possible, at least not with ordinary lubricating oils. This may be attributed to the high insulating properties of these oils, and to the dependence of the breakdown voltage on the previous electrical history of the film.



Apparatus for measurement of oil-film thickness between disks by electrical conductivity (58—A-253)

Research was conducted in an attempt to obtain an additive which would improve the electrical conductivity of the oil, and would impart to the oil certain basic qualities which would render it suitable for use in this method of measurement.

The apparatus described in this paper is virtually a length-measuring device in which oil films may be formed between two stationary disks whose distance apart can be finely adjusted and precisely measured. The disks are set at a given distance apart and the electrical current flowing through the film is measured for specified potential applied across it. This would lead to some relation between the oil-film resistance and relevant thickness at the thinnest section. Such relation would be very useful for interpreting current measurements for the rotating disk testing machine.

Admixing Castrolite 20 A oil with sodium-petroleum sulfonate (in the strength of up to 4 per cent) greatly increases its electrical conductivity and extends its range of ohmic-resistance behavior for the same gap and applied potential. The additive seems to relieve the oil almost completely from its dependence on the electrical history and temperature. The resistive behavior of treated oil, for a given film thickness, is found to be almost unaffected by the removal and reapplication of potential, even if it exceeds the breakdown value. The additive also makes more gradual the rate of change of resistance with film thickness for the same applied potential.

Eventually a reliable relationship between the oil-film resistance and the oil-film thickness would emerge, and consequently the method of electrical conductivity could be applied successfully to the measurement of oil-film thickness between gear teeth.

Oscillating Journal-Bearing Oil-Film Study............58—A-156

By G. G. Nelson, Lieutenant, USN, and K. Gatcombe, Mem. ASME, U. S. Naval Postgraduate School, Monterey, Calif. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

A 1-in-diam steel journal was supported in two nontest bearings. It was oscillated through a total angle of 30 deg with nearly simple harmonic motion.

A single test bearing 1-in. diam and 1 in. long was supported in space by the journal, the loading cable, and the strain-gage system. Hydrodynamic films were or were not established, depending upon the load, the speed, and the phase of oscillation.

In general, three characteristic variations of friction were observed: (*a*) A sinusoidal variation; (*b*) a constant value; (*c*) a special form in which there was a definite increase in the friction at the ends of the stroke, which gave a clear indication that the film changed thickness at the ends of the stroke. The electrical resistance system also clearly indicated the relative thickness of the film at various phases of oscillation, showing that a film may be established at mid-stroke and that boundary film conditions may exist at the ends of the stroke. Measured coefficients of friction for the mid-stroke phase ranged from 0.071 to 0.013.

An Analog Study of Levapad Stability.................58—A-287

By D. J. Jay and H. W. Peithman, Assoc. Mem. ASME, Ford Motor Company, Dearborn, Mich. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

A method of supporting a vehicle above a rail or roadway on a film of pressurized air was demonstrated recently. Termed "levapad," the basic support device is an air-lubricated slider bearing. Each levapad consists essentially of a flat bearing surface with a central outlet connected to a source of pressurized gas. In operation, the gas flows from the outlet to the atmosphere, passing between the rail surface and the bearing surface to serve as both air cushion and lubricant.

Early in the levapad investigation, unwanted vibration was encountered at some conditions of load and weight flow of gas, and a vibration test stand was set up. On the test stand, operation of the levapad is inverted; that is, the pressurized gas is supplied through a fixed lower pad, and the upper pad was permitted to move.

This early levapad, or Levapad I, showed definite, self-excited vibration periods on the test stand. It was obvious that the only source of energy to sustain vibration was pressurized air flowing through the system. On this basis, a study was undertaken to determine the relationship of factors contributing to the self-excited vibration.

A set of nonlinear differential equations was derived to describe the self-excited vibration of an early levapad type. These equations were solved on the department electronic analog computer.

The theoretical solution which included a nonlinear damping term in the equation of motion agreed favorably with the experimental results of the Levapad I type for the one set of conditions considered. The study demonstrated the manner in which the relationship of the various parameters produced the self-excited condition and indicated how a system might be designed to eliminate the vibration. See also: MECHANICAL ENGINEERING, February, 1959, pp. 82-83.

A Study of Dynamic Friction...........................58—A-257

By N. H. Cook, Massachusetts Institute of Technology, Cambridge, Mass. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The study of dynamic friction was motivated initially by the question of whether or not steady-state-friction data are applicable to nonsteady-state (dynamic) conditions. Any case of vibratory motion superposed on a steady sliding motion will give nonsteady-state friction. Where rubbing occurs, it is generally desirable to maintain steady conditions, for example, journal bearings, slide bearings, contact between ball bearings, balls, and separators, metal-cutting tools, and the like.

In this paper theories associated with self-excited vibrations between sliding members are reviewed and extended. The frictional effects due to continually varying sliding speeds are discussed.

Effect of Polymer Structure on the Viscosity Properties of Polymer Solutions.............58—A-294

By E. E. Klaus and M. R. Fenske, The Pennsylvania State University, University Park, Pa.; and R. M. Jolie, The Lubrizol Company, Cleveland, Ohio. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The use of polymer thickened hydraulic fluids and lubricants has become commonplace in the automotive and aircraft fields.

The general use of polymer thickened fluids is based primarily on the ability of the polymer to improve substantially the viscosity-temperature properties of the solution to allow satisfactory application over a wider temperature range. More recent developments have extended multiple functionality to polymeric additives to produce, in some cases, pour depressant and/or dispersant (detergent) effects as well as improvements in viscosity-temperature characteristics.

Basically, however, the linear-type polymeric additives have specific effects on the viscosity properties of their solutions. Four of the more important of these are: (*a*) Thickening; (*b*) improvement of vicosity-temperature characteristics; (*c*) temporary (reversible) viscosity loss due to shear in streamline flow (non-Newtonian behavior); and (*d*) permanent loss of viscosity under conditions of high turbulence and attrition.

Previous studies (with commercial-type polymers) have demonstrated substantial differences between the general types, polybutene, polymethacrylate, and polystyrene in terms of the interrelation of the four viscosity effects noted previously. Within a specific polymer type, variation of viscosity effects has also been demonstrated for changes in molecular weight.

It is the purpose of this paper to assay more critically the effect of polymer structure on these viscosity effects. The polymers used in this study include polymethacrylates, polyacrylates, polyesters, and polybutenes.

A technique is described for the comparison of polymer effect as a function of polymer structure by minimizing or eliminating the effects of polymer concentration and molecular weight.

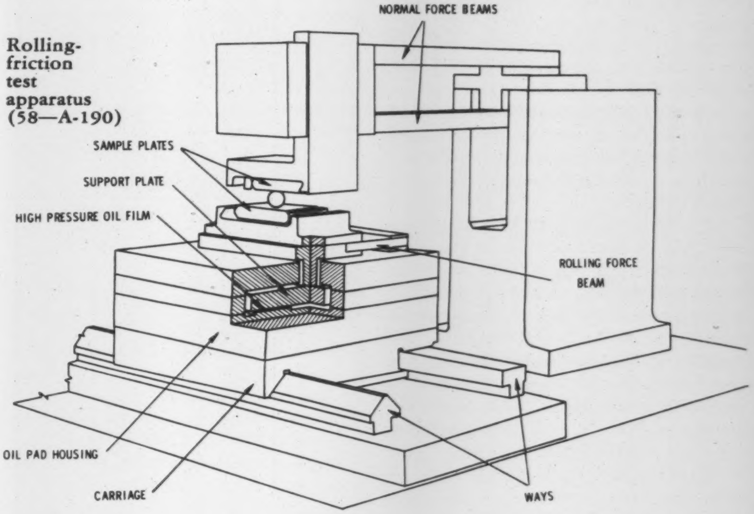
Energy Losses of Balls Rolling on Plates.................58—A-190

By R. C. Drutowski, General Motors Corporation, Detroit, Mich. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

Apparatus for measuring the rolling force of a ball supported between two plates is described.

The rolling-friction force is an extremely small quantity compared to the normal force and the rolling test apparatus had to be designed so that the normal force acting vertically did not interfere with the measurement of the small friction force acting horizontally. To accomplish this the bottom plate is supported on a high-pressure film of oil. This oil film supports the load while offering practically no resistance (at the low shear rates encountered) to the lateral movement of the plate in response to the rolling-friction force.

Instantaneous values of the rolling force vary greatly from point to point on the sample surface and this variation is explained in terms of surface roughness and material homogeneity. The energy losses of balls rolling on plates are shown as functions of load, material, and surface roughness. The rolling of a ball on a plate is examined as a cyclic process in which elastic hysteresis losses appear to be the primary source of energy dissipation. An analysis involving the Hertzian contact stress field is used to derive an equation relating the rolling force and the material damping capacity.



Rolling-friction test apparatus (58—A-190)

• •

Management

Data Collection for the Design and Evaluation of Man-Machine Systems.................58—A-241

By J. H. Ely, Dunlap and Associates, Inc., Stamford, Conn. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Measurement of human performance in a man-machine system serves two important functions: (*a*) Provides part of the data necessary to evaluate the effectiveness of an operational system; and (*b*) provides basic information required by the system designer for design of future systems.

The problems and procedures for collecting data on human behavior in nonlaboratory situations are treated in this paper.

A prerequisite to any data collection for a man-machine system is a clearly defined statement of the purpose or goal of that particular system. Precise definition of the specific requirements of the system makes simpler the determination of the type of data to be collected.

Operators being used as subjects for data collection should be a representative sample of the ultimate user population. It is important that they be representative not only in their level of skill but also in their degree of motivation.

The advantages and disadvantages of simulated versus field measurements are mentioned briefly.

The characteristic of human behavior which causes the greatest concern to the data collector is variability. To compensate for variability it is necessary to repeat measurements of the same task. Exact statistical techniques are available for determining the number of repeated trials which should be made on the same task in order to provide a given degree of certainty.

The merits of objective and subjective data collection are given in the paper.

Sampling of data, treating low-probability events, special techniques for data collection, eye-movement and activity analysis, critical incident technique, and depth interviewing are each treated briefly.

Applied Mechanics

Determination of the Creep Deflection of a Rivet in Double Shear ....58—A-47

By Joseph Marin, Mem. ASME, The Pennsylvania State University, University Park, Pa. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

Structural components of modern aircraft are subjected to elevated temperatures by jet power plants and by skin friction resulting from supersonic speeds. Some of these high-temperature-aircraft structural components are riveted connections. Considerable experimental data are available on the creep of riveted connections used in aircraft. However, a survey of the literature shows a lack of results on the theoretical prediction of creep in riveted connections from the usual creep and creep-rupture data for simple tension. The creep of a riveted joint is dependent on various factors including rivet diameter, rivet lengths, and plate thicknesses. This influence of size means that each particular riveted joint must be tested to obtain the necessary information. A basic approach to the problem is theoretically to predict the creep behavior of riveted joints from creep in simple tension. One of the important parts of the creep deformation of a riveted connection is the creep of the rivet. This paper deals with an approximate theoretical prediction of the creep deflection in a rivet based upon the creep constants of the material in simple tension.

Stresses in a Stretched Slab Having a Spherical Cavity......58—A-45

By Chih-Bing Ling, Aeronautical Research Laboratory, Taichung, and Institute of Mathematics, Academia Sinica, Taipei, China. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

An analytic solution for an infinite slab having a symmetrically located spherical cavity when it is stretched by an all-round tension is presented in this paper. The required stress function is constructed by combining linearly two sets of periodic biharmonic functions and a biharmonic integral. The sets of biharmonic functions are derived from two fundamental functions specially built up for the purpose. The arbitrary functions involved in the biharmonic integral are first adjusted to satisfy the boundary conditions on the surfaces of the slab by applying the Hankel transform of zero order. Then the stress function is expanded in spherical co-ordinates and the boundary conditions on the surface of the cavity are satisfied by adjusting the coefficients of superposition attached to the sets of biharmonic functions. The resulting system of linear equations is solved by the method of successive approximations. The solution is finally illustrated by numerical examples for two radii of the cavity.

An Application of Statistics to the Dimensioning of Machine Parts.... ....58—A-44

By M. F. Spotts, Mem. ASME, Northwestern University, Evanston, Ill. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

An outstanding industrial achievement during recent years has been the development of quality control and acceptance sampling methods for the purpose of maintaining the high standards of manufactured products. It is equally important to make use of statistics in the engineering office in connection with the dimensioning of machine parts. This paper will be concerned with the dimensioning of assemblies, and will demonstrate how it is possible to maintain tolerances for proper engineering functioning, and at the same time widen the tolerances so far as production is concerned.

Direct Determination of Stresses in Plane Elasticity Problems Based on the Properties of Isostatics........ ....58—A-43

By P. S. Theocaris, Assoc. Mem. ASME, Illinois Institute of Technology, Chicago, Ill. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

An experimental method is developed for the calculation of stresses in plane elasticity problems. The method consists substantially in determining a function of the complex variable representing the field of isostatics. This function has a convenient form so that the boundary conditions can be expressed by simple relations. From the isostatics, which are traced experimentally, the differential parameter of first order *h* can be calculated all over the field. The components of stresses are expressed by relations depending on boundary conditions and the parameter *h*. The method is applied to two particular problems of plane elasticity.

The Effect of Nonisothermal Free Stream on Boundary-Layer Heat Transfer...............58—A-42

By E. M. Sparrow, Assoc. Mem. ASME, and J. L. Gregg, NASA, Lewis Research Center, Cleveland, Ohio. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

An analysis is made for laminar forced-convection heat transfer from a flat plate to a nonisothermal free stream. An exact solution of the boundary-layer energy equation is found for the situation of linearly varying free-stream temperature. Numerical calculations are carried out for Prandtl numbers in the range $0.01 \leq \mathrm{Pr} \leq 50$. Results are presented for the change in heat transfer due to the variation in free-stream temperature. This effect decreases with increasing Prandtl number.

An Experimental Surface-Wave Method for Recording Force-Time Curves in Elastic Impacts. 58—A-51

By J. N. Goodier, Mem. ASME, Stanford University, Stanford, Calif.; W. E. Jahsman, Assoc. Mem. ASME, Lockheed Missile Systems Division, Palo Alto, Calif.; and E. A. Ripperger, Mem. ASME, University of Texas, Austin, Texas. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Appl. Mech.;* available to Oct. 1, 1959).

The recording of impacts by means of the longitudinal strain wave generated in a Hopkinson pressure bar is no longer possible when the impact is very brief, on account of dispersive effects. The Rayleigh surface wave generated on the plane surface of a block is nondispersive. A method is given for deducing the force-time curve of the impact from the oscilloscope record of the surface wave, and applied to impacts of small steel balls on a block.

Furnace Performance Factors

Use of Flow Models for Boiler-Furnace Design........58—A-120

By R. W. Curtis and L. E. Johnson, The Babcock & Wilcox Company, Alliance, Ohio. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Engng. for Power;* available to Oct. 1, 1959).

Much of the work in boiler and furnace design concerns the determination of the shape and size of ducts, pipes, and enclosures that will produce efficient flow of air, gases, and fluid fuels to and through the system. It is now well recognized that the flow-distribution patterns of furnace gases affect the efficiency of combustion, the heat transfer to furnace surface, the amount and location of furnace and superheater fouling, and the rate of deterioration of furnace and superheater surface due to corrosion, erosion, wastage, and so on. Except for simple configurations, the prediction of these flow patterns is impractical or impossible by ordinary analytical methods, and even though it might be possible to write differential equations for certain flow conditions, it is not always possible to solve them. The use of scale flow models is an excellent method for solving flow problems.

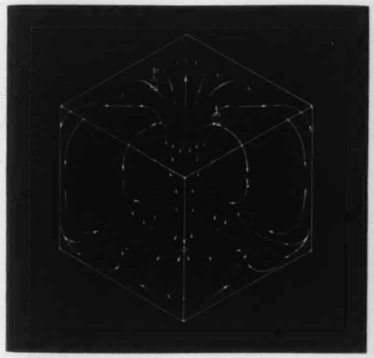
A considerable amount of literature is available on the general theory and design of models, and a number of articles have been written concerning the use of models to solve specific problems. Relatively few of these, however, relate specifically to furnace design. This paper deals primarily with the use of models by the authors' company to solve flow problems encountered in boiler-furnace design. It includes a description of the types of models used, methods of testing each type, the particular advantages and applications of each type, and, as a specific example, the use made of models in establishing the furnace arrangement for the first commercial supercritical-pressure steam generator now installed and operating at the Philo Plant of the Ohio Power Company.

Basic Principles of Combustion-Model Research.........58—A-73

By A. A. Putnam, Mem. ASME, and E. W. Ungar, Assoc. Mem. ASME, Battelle Memorial Institute, Columbus, Ohio. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Engng. for Power;* available to Oct. 1, 1959).

The use of models in scientific research is well known. One may cite the examples of wind tunnels used to study flight problems, models of river beds used to study erosion of soil and proper placement of levees, the use of water channels to study ship models, and the recent use of hypersonic shock tubes and tunnels to study the hypersonic-flight regime. Less well known is the use of models to study problems encountered in the design of commercial and industrial combustion equipment. Yet, as wide a range of factors is covered in these studies as in those previously cited. Combustion efficiency and stability are of interest. Pressure losses, flow patterns, erosion, and deposition patterns attract much attention. Heat transfer by conduction, convection, and radiation are all important.

With one basic technique, that of modeling a combustion unit, being used to obtain information relative to such a variety of subjects, it is well to inquire as to the actual limits of the technique. Such an inquiry is the more important when it is realized that it is extremely easy to show by rigorous reasoning that, where a combustion process is involved, it is impossible to model a combustion unit with anything other than the actual unit run at the conditions of interest. Yet, the fact that modeling techniques have been used for years, both in a predictive and a diagnostic sense, indicates that this line of reasoning is not entirely correct. It is therefore well to apply some measure of validity to the possible uses of modeling.



Particularly interesting to the furnace operator is the result obtained when a jet is fired normally through the center of one face of a cube (58—A-72)

This paper first considers the basic assumptions upon which cold-flow modeling of combustion systems is carried out. Next, some applications of modeling to various combustion problems are considered. Finally, the type of results that should be expected from the application of modeling techniques are discussed.

The Aerodynamic Approach to Furnace Design.............58—A-72

By J. H. Chesters, The United Steel Companies, Ltd., Moorgate, Rotherham, Yorkshire, England. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Engng. for Power;* available to Oct. 1, 1959).

Flow patterns and mixing in actual furnaces can be best appreciated by starting with free jets and proceeding via jets in simple envelopes to jets (cold or alight) fed with surrounding air streams and impacting on surfaces. The fuel stream in an open-hearth furnace behaves initially as a free jet, entraining the relatively low velocity air around it, but on hitting the bath it splashes and runs forward and up the side walls. The gases reaching the roof eject flux droplets and then divide, part recirculating to meet the oncoming air and part joining the main flow to the exit. Future progress requires more knowledge of droplet dynamics and demands more symmetrical flow, control of recirculation, or radical changes.

Use of Models for Studying Pulverized-Coal Burner Performance.........................58—A-95

By G. C. Whitney, Foster Wheeler Corporation, New York, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Engng. for Power;* available to Oct. 1, 1959).

During the past decade the use of small scale models in the testing and developing of various pulverized fuel system components has been increased. Illuminated plastic and steel models operating with air and graded wood dust offer many advantages.

1 Visibility is excellent providing quick, reliable, visual, evaluation of experimental changes.

2 Model changes can be made quickly and inexpensively. This makes it economically feasible to try a wide range of ideas from which a much smaller group can be selected for more complete investigation.

3 Many times it is physically impossible as well as economically impractical to arrange full scale tests. In pulverized coal work it has been impossible to get enough illumination or enough penetration of vision to be able to make observations.

The first model investigation involved the construction of one eighth scale wood and plastic models of the primary air and coal portion of a pulverized coal burner with external illumination. Graded hardwood dust with no plus 30 mesh or more than 10 per cent minus 200 mesh material was used instead of coal. Visibility was excellent and the qualitative results of one of the models were indicative of a satisfactory solution of the distribution problem.

The results of a model test are only of value if they can be correlated with the performance of the actual equipment. In this case the correlation involved variations in air temperature, dust density, size, and particle shape, as well as dimension. Fortunately, a three-step program of evaluating these factors was arranged, and is described in this paper.

……

Mechanical Pressure Elements

Some Factors Affecting the Performance of Corrugated Diaphragm Capsules Having a Deflection Nonlinear With Pressure....58—A-169

By W. G. Brombacher, Mem. ASME, and C. J. Jenny, Eclipse-Pioneer Division, Bendix Aviation Corporation, Teterboro, N. J. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Pressure-deflection data on more than 875 corrugated diaphragm capsules of 17 basic corrugation designs obtained at the Eclipse-Pioneer Division, Bendix Aviation Corporation, during the course of development of a capsule to meet a specified nonlinear pressure-deflection curve were analyzed for general conclusions useful in manufacture and design.

A single capsule was made for each uniform change in the depth of the corrugations of each basic design, for each of several heat-treatments, and for each of different thicknesses and initial hardnesses of the beryllium-copper blanks, in order to determine the effect of these factors on the performance. From a study of these data conclusions were drawn in so far as possible principally on the effect of heat-treatment, of initial hardness of the material, of uniformity of performance from presumably like beryllium-copper sheets, and of the variations in corrugation depth and design.

Theory of High-Pressure Bourdon Tubes................58—A-119

By W. Wuest, Aerodynamic Research Institute, Göttingen, Germany. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Thick-walled tubes of the Bourdon-tube type are frequently used in industry for measuring high pressures in the range of 100 to 10,000 atm. These tubes are made by flattening a circular tube and fitting it to a curve. The theory of these high-pressure tubes goes back to a flat deformation state, and the stresses and deformations are calculated, with cross-sectional shape idealized by a rectangular middle section and two end arcs (flat-oval cross section). A circular cross section is also treated as a special case. Different corrections of essential effect apply to circular or circle-like cross sections; these corrections also have been derived. Finally the law of deflection of such tubes has been investigated.

Bending and Stretching of Corrugated Diaphragms......58—A-62

By R. F. Dressler, National Bureau of Standards, Washington, D. C. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

A corrugated diaphragm is a mechanical pressure element with many important applications. It can be considered as a rotationally symmetric elastic shell with a pattern containing several concentric ridges, which is deflected to an equilibrium position under an applied load such as air pressure.

Solutions of the exact linear elastic-shell equations for all stresses and displacements are presented for a typical corrugated-diaphragm shape for three thicknesses varying over a 9 to 1 range. Results were obtained by numerical integration using an electronic digital computer. The effect of thickness-diameter-ratio variation is discussed with respect to both stresses and resultants, and peak values needed for design purposes are presented. Circumferential and meridional stresses are found to be equally important throughout the thickness range analyzed. Bending and membrane stresses are likewise equally important throughout the range. Peak values in some cases occur near the outer rim.

The Dynamic Response Behavior of Diaphragms in Relation to the Driving Function and Surrounding Media................58—A-224

By F. F. Liu, Dresser Dynamics, Inc., Subsidiary of Dresser Industries, Inc., Northridge, Calif. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

In the study of dynamic diaphragm behavior efforts have been channeled into the following areas:

1 The study of vibrational characteristics of the diaphragm itself.

2 The study of the dynamic phenomena of the medium, or material carrier, which has been applied to the diaphragm in terms of acoustical or hydraulic phenomena both in front of and behind the diaphragm.

3 A combined approach which enables an objective study of the interaction between the diaphragm's vibrational characteristics and behavior of the medium.

An adequate treatment of the diaphragm's dynamic response, however, should take an integrated approach, recognizing that one of the principal functions of the diaphragm is to enable a certain unknown physical, or more specifically, fluid-dynamical phenomenon to be measured.

A broad, though abbreviated, approach to the analysis of the dynamic behaviors of diaphragms under the influence of various external and internal factors is presented. It shows that a large number of factors are to be anticipated during an objective study of diaphragm's response. Among other things, these are: Molecular movement of gas in front of the diaphragm; matching of the acoustical and mechanical impedance; the vibrational behaviors of the diaphragm; and the influence of external and internal damping.

Tests on Deflection of Flat Oval Bourdon Tubes.........58—A-67

By G. Kardos, Assoc. Mem. ASME, Aviation Electric Limited, Montreal, Quebec, Canada. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

The published data presently available on the deflection characteristics of Bourdon tubes are sketchy. To date completely satisfactory theoretical evaluations have not been made. Until a satisfactory theory is determined, and to provide data against which it can be checked, empirical data of the characteristics are desired. The Special Research Committee on Mechanical Pressure Elements of The American Society of Mechanical Engineers have taken the first steps to gather these empirical data. Information was solicited by the Committee from fifty manufacturers, of Bourdon tubes. These data show a great deal of variation, primarily because the data supplied were of a production nature.

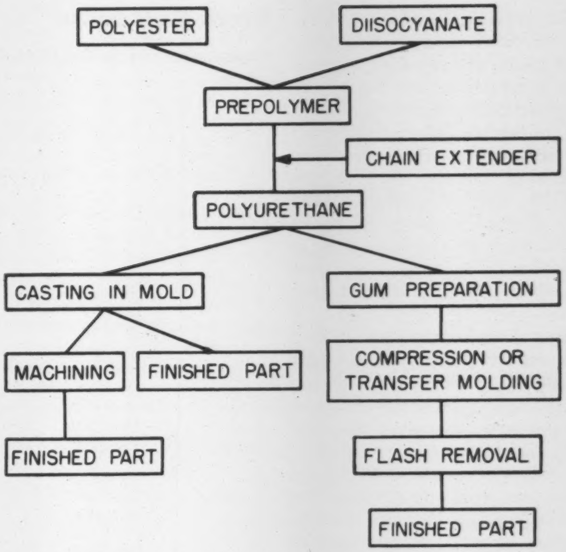
It was the purpose of this study to produce and determine the deflection characteristics of a wide range of tubes of similar cross section, the flat oval. Against the test results the leading deflection theories were checked and an attempt made to evaluate empirically the deflection characteristics.

Rubber and Plastics

Applications of Solid Polyurethane

.....................58—A-285

By K. H. Grim, Mem. ASME, Disogrin Industries, Inc., Mount Vernon, N. Y. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).



Manufacturing process for solid polyurethane (58—A-285)

Fabrication of parts from polyurethanes begins with the proper preparation of the raw material. The polyester is first dehydrated. To this liquid polyester is added the diisocyanate to form the prepolymer. The prepolymer is formed under a vacuum to exclude moisture and is liquid at the temperature reached. The exothermic reaction which forms the prepolymer is followed very closely by plotting a temperature-time curve. The cross-linker is added to the prepolymer and the raw material is ready for liquid casting. Parts also may be made by pressure molding or by transfer molding. Before a part can be pressure or transfer molded, however, a suitable blank must be prepared by milling.

After forming by one of the foregoing methods, the part requires aging in an oven at closely controlled temperatures to continue the cross-linking of the molecular chains. When the cross-linking has been completed, the part can be machined as required if it has been cast. If it has been pressure or transfer molded, it will require removal of flash. Owing to the exceptionally good low-temperature properties of polyurethanes, removal of flash by tumbling is not feasible.

In this country, polyurethane first found successful application in a bladder for a hydraulic accumulator. Raw material costs and manufacturing techniques, however, did not permit extensive production.

Another of the early applications of the material was contact wheels for belt-grinding machines. Excellent abrasion resistance of the material and its ability to be bonded to metal and then shaped to desired contours make this a successful application.

Most dramatic of the applications of polyurethane is its use in airplane wheels. During carrier landings some jet aircraft are arrested by gear which forcibly slams the tail of the airplane onto the deck. Solid-rubber-tired wheels were used as the tail bumper on one type of carrier-based plane, five landings were considered good performance and often failures resulted after two. Polyurethane-tired wheels have withstood as many as 140 landings before failure.

Other applications include: Liquid-oxygen containers, pump stators and impellers, wire-measuring wheels, lift-truck wheels, and many others.

……

Power

Load Capacity Tests on Tapered-Land and Pivoted-Shoe Thrust Bearings for Large Steam-Turbine Application

..........58—A-172

By R. E. Brandon, Assoc. Mem. ASME, and H. C. Bahr, Mem. ASME, General Electric Company, Schenectady, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Engng. for Power;* available to Oct. 1, 1959).

The past decade has seen large increases in steam-turbine capacities and in initial steam conditions. These changes have increased both potential thrust and shaft diameters which in turn require thrust bearings with greater area, and operating at larger diameters.

For years the authors' company has been the only major turbine manufacturer to utilize tapered-land thrust bearings. Development tests made approximately 25 years ago by Sheppard established the characteristics and design of tapered-land thrust bearings for a broad range of application. In addition to the broad experience with tapered-land thrust bearings, experience has been obtained with pivoted-shoe bearings on some 25 of the largest central station turbine-generators installed between 1954 and 1956.

In 1953 a testing program was initiated to determine the characteristics and load-carrying capacity of both types of thrust bearings. It was hoped the tests would reveal what effect, if any, the continued increases in bearing size and runner speed have had on load-carrying capacity.

Also sought was a basis that could be established for the selection of either type of bearing.

Results of full-scale maximum load capacity tests on large, 3600 rpm, pivoted-shoe, and tapered-land thrust bearings are reported. The results show 700 psi capacity for the pivoted-shoe bearing, and 1085 psi for the tapered-land type. Additional evidence of thermal distortion and its effect on thrust-bearing capacity is discussed.

A brief description of a new thrust-bearing test installation also is included.

A Three-Dimensional Photoelastic Study of Stresses Around Reinforced Outlets in Pressure Vessels

.....................58—A-148

By C. E. Taylor, Assoc. Mem. ASME, N. C. Lind, and J. W. Schweiker, University of Illinois, Urbana, Ill. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Almost without exception, every practical pressure vessel must have some openings or connections for supplying pressure, for providing access to the interior, or for other functional reasons. When the diameter of an opening becomes appreciable compared to the size of the vessel, the localized stresses in the region near the opening become extremely important. In the design of pressure vessels with reinforced outlets, three major types of loads must be considered: (*a*) Internal or external pressure; (*b*) forces or moments acting on the outlet; and (*c*) thermal stresses. The scope of this paper includes only the effect of internal pressure.

This paper describes the three-dimensional photoelastic determination of the stresses around cylindrical outlets in spherical and cylindrical shells loaded by internal pressure. Several sizes and shapes of reinforcement were tested to study the effects of certain variables and to determine an optimum design. The results are tabulated in the form of stress-concentration factors. Distribution of the principal stresses on the surfaces of some typical models are included.

The Challenge to American Science and Engineering........58—A-66

By Allen Kent and J. W. Perry, Center for Documentation and Communication Research, Western Reserve University, Cleveland, Ohio. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The rapidly expanding research facilities of government agencies, universities, and industrial concerns have been pouring forth a cascade of new knowledge so great that existing arrangements for collecting and organizing the records no longer can control the flood. The inability to lay hands quickly on essential information leads to enormous intellectual and social waste which no business, no industry, and no government activity can either escape or afford. Because of the chaotic state of our documentation services, our stockpile of knowledge has become an embarrassment of riches and we find ourselves ignorant in the midst of a plethora of knowledge.

In order to help meet the challenge presented by this problem, Western Reserve University established in 1955 a Center for Documentation and Communication Research as the research arm of the School of Library Science. A number of interesting and important problems have been under investigation, among them the mechanized searching and correlation of scientific and technical recorded information. A progress report is presented—together with an estimate of what industry will be able to expect in the way of service.

Fluid Mechanics

Stall Prediction in Gas-Turbine Engines.................58—A-133

By R. J. Lubick and L. E. Wallner, NASA, Lewis Research Center, Cleveland, Ohio. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.*; available to Oct. 1, 1959).

An intensive study of gas-turbine engines for aircraft propulsion has been conducted by the NASA at the Lewis Flight Propulsion Laboratory, now Lewis Research Center of the NASA. One of the most important operating limits, which has been ever present in the running of these machines, is the phenomenon commonly referred to as compressor stall. This general phenomenon of compressor stall produces a host of problems, many of which have busied researchers at several different laboratories in search of a solution.

Compressor stall is defined in this paper as "a sudden sending back of the compressed fluid through the compressor and into the atmosphere." Greatest concern is with the compressor stall that results in surging and thus represents a positive

KEEP CLEAR WHEN
RUNNING

Multistage-compressor performance is obtained by a series of altitude chamber tests of full-scale turbojet engines. Turbojet installation in altitude wind tunnel. (58—A-133)

Heat Transfer

Hydraulic Jetting Tools for Cleaning Heat Exchangers...58—A-217

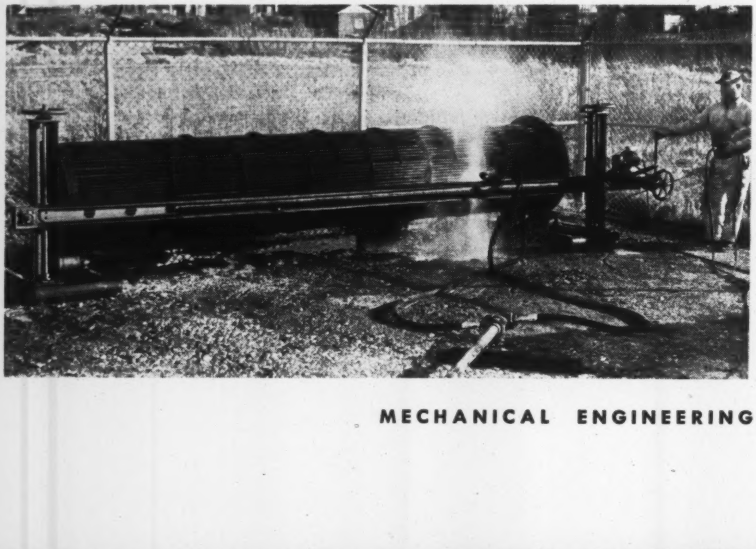
By B. L. Canaday, Dowell Division, The Dow Chemical Company, Tulsa, Okla. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

A frequently encountered maintenance problem is the removal of scale deposits from heat-exchange equipment. Such deposits not only impede heat transfer, making the unit less efficient, but by their bulk restrict flow through the unit.

A recent trend in cleaning heat-exchange equipment has been the development of a new technique in which the deposits are removed by high-velocity jet streams of water.

One major application for hydraulic jet cleaning has been the removal of

Bundle-cleaning assembly consists of framework to hold tube bundle, jet head containing 16 jet orifices, and beam-trolley assembly to facilitate application of jets, and to withstand the reaction force of the high-velocity water streams (58—A-217)



operating limit for the machine. This does not mean that some of the other varieties of stall, such as the rotating type in the low-speed regime, are not important, but rather that the scope of the work presented in this paper is limited to the higher compressor speeds where stall generally results in the violent flow oscillations called compressor surge.

From a study of multistage compressors operating in gas-turbine engines the sequence of events which occur during the stall process was determined. By using this information and stage-characteristic curves, it is shown that the compressor stall limit may be computed for any disturbance.

On the Nature of Stall . . 58—A-170

By S. J. Kline, Mem. ASME, Stanford University, Stanford, Calif. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

The physical data available on the problem of stall are reviewed. The discussion is centered on the problem of flow in passages. The emphasis is placed on systematic visual data showing flow patterns as a function of geometrical parameters.

These data lead to a view of stall as a spectrum including three or possibly four major types of flow patterns; these patterns involve both transient and steady elements. A qualitative parameter is formulated which provides a classification for the major types of stall. It is shown that this parameter and its underlying concepts are useful in rationalizing known but previously inexplicable results, and in obtaining important qualitative predictions. Comparisons between the predictions of boundary-layer theory and the actual systematic stall data of passages are given.

Some Measurements of Boundary-Layer Growth in a Two-Dimensional Diffuser . . . . 58—A-196

By J. F. Norbury, University of Liverpool, Liverpool, England. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

Low-speed experiments were carried out in a two-dimensional diffuser having a square throat and an area ratio of two to one. Measurements were made of static pressure distribution, velocity contours at throat and outlet, and boundary-layer growth along the four wall center lines. Visual flow experiments were performed using tufts and smoke filaments. Similar experiments were carried out with the throat boundary layers artificially thickened by means of round rods placed on the walls upstream. Disparities between the measured growth of momentum thickness and that predicted by the simple momentum equation are discussed, as well as the effect of the artificial thickening on diffuser efficiency.

The Skewed Boundary Layer . . . . 58—A-113

By E. S. Taylor, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.;* available to Oct. 1, 1959).

The geometry of the skewed boundary layer is described, and two methods of producing it are discussed. Experimental results show that the form of the usual skewed boundary layer is a thin collateral sublayer under a quasi-collateral outer region. The geometry of separation of a skewed boundary layer is discussed. It is concluded that separation of a skewed boundary layer may differ radically from that of a collateral boundary layer and that separation criteria used for collateral boundary layers may give misleading results when applied to skewed boundary layers. It is concluded that the understanding of the skewed boundary layer can contribute to improved design of turbomachinery.

……

fouling deposits from regenerative air preheaters, such as are used with many boilers.

Another application for this type of deposit removal has been in cleaning heat-exchanger bundles in refineries and petrochemical plants.

Basically, the special equipment required to perform a deposit-removal operation by the jet-cleaning technique consists of a mobile, high-pressure pumping unit, a suitable jet head containing properly designed nozzles, and such associated piping as may be required. Several types of truck-mounted pumping equipment have been developed for use in chemical cleaning treatments. A typical unit employs positive-displacement, triplex pumps that are designed to deliver 65 gpm at 3000 psi. Heavy-duty twin-diesel powered units are capable of supplying up to 175 gpm at 3000 psi.

Use of these new tools offers several advantages over other cleaning methods. Hydraulic jetting tools provide quicker, more thorough cleaning, and often make possible deposit removal that cannot be accomplished by other methods. Jetting is noncorrosive and in most cases is less expensive than other mechanical cleaning methods.

Special jet nozzles have been developed which provide solid streams that retain high velocity for distances as great as 20 ft. These orifices are an important factor in the success of hydraulic cleaning tools. Truck-mounted pumps supply these hydraulic jetting tools with large volumes of water at high pressures. Pumps and orifices of different sizes and capacities are available, so that equipment can be selected to remove deposits effectively.

Transient Temperature Responses and Elastic Thermal Stresses on Asymmetrical Heated Plates and Shells . . . . 58—A-216

By Y. S. Tang, Westinghouse Electric Corporation, Pittsburgh, Pa. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Most of the published charts and tabulations for transient heat conduction and thermal-stress computations are limited to simple shapes and simplified boundary conditions. The present work extends these data to include the response of shells (hollow circular cylinders) and the effects of asymmetry of ambient temperatures and/or surface conductances at both surfaces of a plate or shell. The temperature responses are represented by the surface and space-mean temperatures.

Charts are presented as correction factors for various conditions to be applied to the classical charts for symmetrical boundary conditions. The maximum elastic thermal stress and the time at which it occurs are reported. A resistance-network analog was used for these calculations. These maximum stresses of shells with $(r_o/r_i) \leqslant 3.5$ are approximately equal to those of plates for both symmetrical and unsymmetrical boundary conditions. Examples of the use of the charts are given.

Growth of Bubbles in a Liquid of Initially Nonuniform Temperature . . . . 58—A-105

By S. G. Bankoff, Mem. ASME, and R. D. Mikesell, California Institute of Technology, Pasadena, Calif. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The Plesset-Zwick solution for the asymptotic-growth phase of a bubble originating in a uniformly heated liquid of infinite extent is extended to the case of a bubble originating from a heating surface in contact with a liquid whose bulk temperature is at or below the saturation temperature. This is, of

Fluid Mechanics (continued)

Labyrinth-Seal Leakage Analysis ....58—A-118

By W. Zabriskie, Assoc. Mem. ASME, and B. Sternlicht, Assoc. Mem. ASME, General Electric Company, Schenectady, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.*; available to Oct. 1, 1959).

The leakage flow through labyrinth seals in turbomachinery has been the subject of increasing concern as refinements and advances in design are made. Accurate knowledge of seal leakage is necessary in at least three areas of design: (*a*) Estimating the effect of seal leakage on performance; (*b*) regulating the leakage flow required for cooling purposes; (*c*) determining the thrust-bearing load which is a function of the pressure drop through the seal.

This paper is concerned primarily with the fluid-flow aspect of gas leakage through labyrinth seals of the types commonly used in gas and steam turbines. This includes staggered and unstaggered seals of the axial type, which are most commonly used in turbomachinery. The attention to fluid-flow considerations does not imply that material compatibility and operating problems of expansion, deformation, and rub-in are unimportant. In fact, these mechanical considerations may overrule the fluid-flow considerations. For the foregoing reasons, it is desirable to be able to predict seal leakage flows, and thus this aspect of seal design has been singled out for consideration here.

Modulation Phenomena in Stall Propagation ....58—A-152

By J. A. Rockett, Pratt and Whitney Aircraft, E. Hartford, Conn. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Basic Engng.*; available to Oct. 1, 1959).

Recent experimental work on stall propagation in a single-stage research compressor is described. At certain fixed operating points, several different stall patterns were found to exist. Transitions from one pattern to the other occurred spontaneously, reversibly, and fairly frequently. These transitions were studied in detail. A regular modulation of the stall-propagation velocity is associated with the transition process. The modulation is used to determine stall frequency as a function of both wave number and mass flow. Stall-cell size measurements, static-pressure surveys, and a study of the region downstream of the stall-propagating rotor are described.

. . . .

Heat Transfer (continued)

course, the usual case in boiling heat transfer.

Viscous, surface tension, and inertial effects are neglected. After a transformation to Lagrangian co-ordinates, the problem is solved analytically for a linear and for an exponential initial temperature distribution. A bubble boundary-layer volume can be chosen so as to make the exponential solution fit experimental bubbles in saturated boiling quite closely, but not in highly subcooled boiling. In the latter case, this is thought to result from the neglect of the turbulent and inertial effects, and possibly from the assumed form of the initial temperature distribution.

Fouling and Cleaning of Power-Plant Heat Exchangers..58—A-289

By C. E. Brune, Mem. ASME, and T. A. Miskimen, American Electric Power Service Corporation, New York, N. Y. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Unfired heat exchangers, principally feedwater heaters, are cleaned by various different methods.

Partial cleaning sometimes may be accomplished by changing operating conditions, either deliberately or incidental to varying load demands. Start-ups and shutdowns resulting in wide flow and temperature variations have been responsible for some cleaning of fouled surfaces. Reversing water flow in steam condensers is a familiar cleaning procedure. Concentrating the entire flow through one of two parallel streams of feedwater heaters in one known instance has improved failing heat transfer. Mechanical cleaning of fouled surfaces is not often used because of the considerable cost in time and labor and because only partial removal is obtained of some deposits. Cleaning by chemical agents is acknowledged as effective, convenient, and safe when correctly applied and adequately supervised.

It will require a major "breakthrough" in the technologies of water treatment or of metallurgy to eliminate all fouling of heat-exchanger surfaces in the power plant from corrosion, scaling, and other deposits. Until such achievements, the power-plant engineer must expect to perform a number of types of cleaning operations during the life of the power plant. He also must determine when it is economical to perform these cleaning jobs. For feedwater heaters, this requires accurate heat balance calculations.

Cleaning is most effectively or efficiently done when adequate facilities have been provided in the original planning and construction of the plant.

A Variational Method for Fully Developed Laminar Heat Transfer in Ducts...............58—A-92

By E. M. Sparrow, Assoc. Mem. ASME, and R. Siegel, Assoc. Mem. ASME, NASA, Lewis Research Center, Cleveland, Ohio. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Heat Transfer;* available to Oct. 1, 1959).

The utility of variational methods as a tool for the solution of complex problems in the theory of elasticity and other fields of applied science is well established. The power of the variational technique has yet to be brought to bear on problems in heat transfer, except for recent work on unsteady conduction.

This report is concerned with forced convection heat transfer and aims to formulate and apply a variational procedure for solving the problem of fully developed heat transfer in noncircular ducts. To demonstrate the method, velocity, and heat-transfer solutions are found for laminar flow in passages of rectangular and of circular sector cross section. In all cases, the heat input per unit length is taken as constant along the passage, but a variety of thermal conditions around the boundary of the cross section are considered.

Attention is focused here on noncircular ducts because of their increasing application in the design of high-performance heat-exchange equipment. In particular, such noncircular configurations may be found in the cores of nuclear reactors, where fuel element may be arranged in various patterns.

A brief description of the general variational procedure is given in the next section, and this is followed by the specific problems.

Full-Scale Human-Body-Model Thermal Exchange Compared With Equational Condensations of Human Calorimetric Data.............................58—A-181

By L. P. Herrington, The John Pierce Foundation, New Haven, Conn. 1958 ASME Annual Meeting paper (multilithographed; to be published in Trans. ASME—*J. Heat Transfer;* available to Oct. 1, 1959).

An earlier paper prepared for the Committee on Biotechnology of the Heat Transfer Division suggested that the empirical human heat-exchange data provided by human calorimeters (and models) is most useful to engineers when they are condensed into multivariate equations. Work was reported to the committee in which by algebraic and least-square concepts a five-element linear differential equation was derived to describe 540 hr of calorimetric data on the seated clothed human subject in the range from 40 to 80 F. The coefficients of this equation establish, for this large data collection, the partial rates of change of the skin boundary temperature with respect to metabolic heat input, evaporative cooling, ambient air, and ambient radiation temperature.

The current report extends this analysis with respect to four principal topics:

1 The comparison of data obtained with electrically heated body models as instruments of measurement with the heat exchange indicated by a linear differential equation for human subjects in the calorimeter.

2 The comparison of the original observed calorimeter data on human subjects with the heat exchange indicated by the equational derivation.

3 The presentation of four new equations representing the response of different segments of the human body to internal and ambient factors affecting heat exchange, and an indication of their use in man-machine problems of heat-tolerance prediction.

4 A report of the extension of this study to instrumentally recorded data of the human calorimeter in the region above 80 F, in which thermally provoked evaporative regulation results in an empirically derived linear differential expression of distinctly different coefficients.

Use of Integral Methods in Transient Heat-Transfer Analysis..........................58—A-248

By W. C. Reynolds, Assoc. Mem. ASME, and T. A. Dolton, Stanford University, Stanford, Calif. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Integral methods have long been used in the analysis of steady two-dimensional boundary layers. In this paper it is seen that these same simple techniques also may be used to obtain approximate solutions to transient heat-transfer problems. Complex transient conduction-convection problems can be handled with relative ease and good results obtained. The examples presented illustrate the integral analysis methodology, accuracy, and simplicity.

This technique may be used to handle multidimensional heat-conduction problems, including the effects of convection, internal heat sources, and variable properties. The method may be extended to transient heat-exchanger analysis and is particularly useful for estimating transient temperatures in a nuclear reactor. One such analysis is included.

Natural Convection Heat Transfer in Closed Vessels With Internal Heat Sources—Analytical and Experimental Study......58—A-212

By F. G. Hammitt, Mem. ASME, University of Michigan, Ann Arbor, Mich. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The phenomenon of natural-convection heat transfer and fluid flow in closed vessels with heat sources internal to the fluid has assumed importance in connection with homogeneous nuclear reactors. It is also prominent in various chemical processes. Natural convection, in the absence of internal-heat sources perhaps under the impetus of an intensified body force, is important also in various applications.

This paper presents the results of an experimental and analytical study on vertical, cylindrical closed cells, containing fluid in which heat is generated internally. The heat is removed through the container walls to maintain steady state. As a special case the analysis is applicable to the condition of no internal heat generation; rather replenishment through open access at one end to an infinite reservoir. It gives a basis for engineering estimates of temperature differentials, velocities, and heat fluxes.

Heat Transfer From an Annular Fin of Constant Thickness..58—A-116

By H. H. Keller, Westinghouse Electric Corporation, Lester, Pa.; and E. V. Somers, Pittsburgh, Pa. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Heat Transfer;* available to Oct. 1, 1959).

A problem of practical engineering interest is that of the diffusion of heat through an annular fin of constant thickness. Interest in fins is prevalent in the many fields of engineering, such as air conditioning, heat-exchanger apparatus, electric motors, and electronics, where, using extended surfaces, engineers have been able to build more compact and efficient heat-transfer apparatus.

The effect of adding fins to a surface immersed in a fluid depends upon a number of factors of which the most important is the increase of exposed surface area. For heat transfer from an interior isothermal surface to an external fluid, there are two factors which determine the rate of heat exchange:

1 Resistance to heat flow through the convective film of the ambient fluid.

2 Conductive resistance to heat flow within the metal fin itself.

Numerous solutions to the problem of diffusion of heat in an annular fin of constant thickness have been presented, but all cases refer to one-dimensional heat flow. An assumption inherent in these solutions is that the fin thickness is sufficiently small compared to its height that temperature gradients normal to the length direction of the fin may be neglected. For fins of large height and small thickness this assumption produces negligible error. For fins with a small height-to-thickness ratio, the error introduced by the one-dimensional assumption becomes important.

The two-dimensional solution for annular fins, given in graphical form with the efficiency plotted versus the design-parameter group $(b - a)[(2b)/(kw)]^{1/2}$, supplies needed design information for fins of small height-to-thickness ratio and large height-to-inner radius ratio. The one-dimensional solutions previously given for annular fins are accurate for height-to-width ratios of the order of 10 or more, while the two-dimensional results for rectangular fins are useful as approximations to annular fins when curvature is not large. With height-to-width ratios less than 10 and for annular fins with large curvature, design of fins can be computed with the results presented in this paper.

Heat Transfer Between Concentric Rotating Cylinders......58—A-99

By I. S. Bjorklund, Shell Development Company, Emeryville, Calif.; and W. M. Kays, Mem. ASME, Stanford University, Stanford, Calif. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Heat Transfer;* available to Oct. 1, 1959).

In a previous paper (see Trans. ASME, vol. 80, 1958, p. 70) the heat transfer from a single rotating cylinder to still air and to a cross-stream of air was investigated. Analysis of the thermal behavior of machinery often involves not only heat transfer from rotating elements to a surrounding fluid of large expanse, but also heat transfer from confined rotating parts. Such a problem might arise in connection with consideration of the thermal behavior of enclosed shafting, multiple concentric drives, turbine rotors, and similar machine parts. Heat transfer from a long rotating cylinder to a concentric cylindrical shell is geometrically the simplest of the possible configurations and perhaps one of the most widely encountered; it has thus been chosen as the subject for investigation.

The objectives of the present work

have been to study the heat-transfer characteristics of such a system and to determine the influences of the ratio of outer to inner cylinder angular velocity η and of the relative radial clearance between the cylinders d/R_1 on the heat-transfer rate. Consideration is restricted to the case of no axial flow of fluid in the annulus between the cylinders.

Liebmann Network Approximations to One-Dimensional Transient Heat-Conduction Problems.............................58—A-221

By R. P. Benedict, Westinghouse Electric Corporation, Lester, Pa. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Stepwise analogical approximations to one-dimensional transient heat-conduction problems are studied. Liebmann's basic resistance-analog method for representing the difference equations which approximate the differential equations which describe one-dimensional heat conduction in a plane wall is reviewed.

The method is then extended to indicate in detail means for handling cylindrical walls, composite walls, fluid films, and adiabatic surfaces on various wall configurations. Pertinent electrical resistance ratios are determined (and tabulated) by drawing analogies between the electric current and heat-flow fields. Sample problems which make use of some of the suggested networks are solved to illustrate the method. Comparisons of the resulting approximations are made against exact solutions and against explicit and implicit numerical approximations to indicate the mathematical stability and convergence of the subject method. A selected bibliography of related work is given.

Combined Geometric and Network Analog Computer for Transient Heat Flow...............58—A-69

By Victor Paschkis, Mem. ASME, Columbia University, New York, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Heat Transfer;* available to Oct. 1, 1959).

The term "analog computer" as used in this paper describes a device which permits the solution of a problem in one field of physics by interpretation of measurements carried out in an "analogous" other field. For example, a problem in heat conduction is solved by appropriate interpretation of electrical measurements on an analogous system. The basis for such computers is the identity of mathematical expressions describing the problem and its "analog"; if the same equation describes several fields (as the Fourier equation, which describes heat conduction, diffusion, and electric currents in noninductive cables), a multiple analogy exists, and the choice in which field to make measurements is strongly influenced by the convenience with which measurements can be made.

The relative ease and accuracy of electrical measurements makes the electrical analog computer a versatile and powerful tool. One can distinguish between two types of analogs: The geometric and the network computer. While the paper deals with analogs for heat flow, the remarks have (in view of multiple analogies) broader applicability.

A method to analyze three-dimensional transient heat flow is described, which comprises a continuous resistance medium but discrete capacitances. After describing the principles of the technique, the several components and their criteria are discussed, and the accuracy is illustrated by comparing the results of several simple problems with analytically determined values.

Heat Transfer to Water in Thin Rectangular Channels..58—A-127

By S. Levy, Assoc. Mem. ASME, and R. O. Niemi, Assoc. Mem. ASME, General Electric Company, San Jose, Calif.; and R. A. Fuller, General Electric Company, Schenectady, N. Y. 1958 ASME Annual Meeting paper (in type; to be published in Trans. ASME—*J. Heat Transfer;* available to Oct. 1, 1959).

Heat-transfer coefficients are presented for water flowing vertically in thin rectangular channels (0.1 × 2.5 in.) 18 and 36 in. long and heated electrically around the entire periphery. The range of variables covered is: 65 to 200 psia pressure, 90 to 200 F subcooling, and 4 to 50 fps water velocity. Heat-transfer correlations are given for data along the narrow and wide faces of the rectangular test section. Burnout data also are reported with steam blanketing occurring first at the corner of the test section. The proposed correlating equation, valid at the narrow face of the test section, gives values considerably lower than those obtained in a circular pipe.

Adiabatic Wall Temperature Downstream of a Single, Tangential Injection Slot...........58—A-107

By J. H. Chin, S. C. Skirvin, Assoc. Mem. ASME, L. E. Hayes, and A. H. Silver, General Electric Company, Cincinnati, Ohio. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

The study of injection of a secondary gas into a boundary layer to provide a "film" of cold or hot gas adjacent to a surface resulted from the application of "film cooling" in rocket engines, jet aircraft components, and "film heating" in wing anti-icing. Preliminary visualization studies with injection slots of different geometries indicated that tangential injection produces less mixing between the injection stream and the main flow and gives a better film than normal injection.

This paper supplements previous results for tangential or semitangential injection, in particular, for regions near the injection slot. In addition, it shows the effect of the main flow boundary-layer thickness upstream of the slot and the effect of cold versus hot injections.

Experimental results are presented for single, tangential slot film cooling, or film heating of an adiabatic flat plate in a subsonic turbulent flow under zero pressure gradient.

Results are correlated in terms of a film effectiveness (defined as the ratio of the temperature difference between initial main stream and local flat plate to that between initial main stream and the injected fluid at the slot) which is expressed as a function of the dimensionless distance downstream from the injection slot (reference to slot height), the initial density and velocity ratios between main and injection streams, the injection Reynolds number (based on slot height), and the mainstream Reynolds number (based on upstream hydrodynamic starting length).

The data of Wieghardt and of Seban, Chan, and Scesa are expressed in terms of the present correlation variables and compared with the present results.

Laminar-Film Condensation of Pure Saturated Vapors at Rest on Nonisothermal Surfaces....58—A-232

By Kamal-Eldin Hassan, Assoc. Mem. ASME, University of Khartoum, Khartoum, Sudan. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

Nusselt's theory of laminar-film condensation is extended to include condensation of nonisothermal surfaces. Cases of condensation on inclined flat plates and cylinders with any known temperature distribution are treated analytically. The results obtained are compared with those calculated under the assumption that the considered surface is isothermal at its integrated mean temperature. Further, condensation on inclined flat plates and horizontal cylinders cooled by fluid streams are similarly treated. The results are compared with those calculated by using the logarithmic mean temperature difference and assuming a constant film coefficient based on isothermal conditions. The problems are expressed and solved in terms of dimensionless groups.

Instruments and Regulators

Dynamic Analysis of the SeaMaster Stabilizer Position Control ....58—A-184

By M. A. Papillo, Assoc. Mem. ASME, The Martin Company, Baltimore, Md. 1958 ASME Annual Meeting paper (multilithographed; available to Oct. 1, 1959).

In the SeaMaster's control system, the pilot or autopilot transmits effort to the stabilizer through a pulley-cable system to a hydraulic control valve which ports fluid to an actuator, which, in turn, positions the stabilizer. A feed system feeds back to the pilot or autopilot synthetic control forces which assist in flying the aircraft.

This paper describes the dynamic characteristics of the SeaMaster stabilizer position control utilizing Laplace transformation and frequency-response techniques. A knowledge of the stabilizer dynamic characteristics is necessary to insure that the servo-position control is dynamically stable and to determine the dynamic characteristics required for over-all aircraft stability and control studies.

ASME TRANSACTIONS

The February, 1959, issues of the Transactions of the ASME—*Journal of Engineering for Industry* and *Journal of Heat Transfer* (available at $1.50 per copy to ASME members; $3 to nonmembers), contain the following:

Journal of Engineering for Industry

Dynamic Loading of Spur Gear Teeth, by A. Y. Attia. (58—SA-32)

Analytical Design of an Ackermann Steering Linkage, by W. A. Wolfe. (58—SA-31)

Structural Error Analysis in Plane Kinematic Synthesis, by Ferdinand Freudenstein. (58—SA-12)

The Design of Linkages to Generate Functions of Two Variables, by C. W. Allen. (58—SA-57)

Helical Springs of Hollow Circular Cross Section, by C. W. Bert. (58—SA-18)

Design of Helical Springs for Minimum Weight, Volume, and Length, by R. T. Hinkle and I. E. Morse, Jr. (58—SA-9)

Stress and Strain in Spinning Paraboloid Dishes, by M. J. Cohen. (58—SA-8)

Torispherical Shells—A Caution to Designers, by G. D. Galletly. (58—Pet-3)

Drilling by Vibration, by R. Simon. (58—Pet-21)

Vibrations of Vertical Pressure Vessels, by C. E. Freese. (58—Pet-13)

Technical Briefs

Revisions to Published Chart: Metals for High-Pressure Hydrogenation Plants, by G. A. Nelson

Journal of Heat Transfer

Wave Theory of Heat Transfer in Film Boiling, by Yan Po Chang. (58—SA-19)

A Boundary-Layer Treatment of Laminar-Film Condensation, by E. M. Sparrow and J. L. Gregg. (58—SA-2)

Transient Response of Heated Air in an Enclosure With Heat Losses, by W. A. Wolfe. (58—SA-3)

Natural-Convection Heat Transfer in Liquids Confined by Two Horizontal Plates and Heated From Below, by Samuel Globe and David Dropkin.

Transient Heat Transfer for Laminar Forced Convection in the Thermal Entrance Region of Flat Ducts, by R. Siegel and E. M. Sparrow. (58—HT-3)

Generalized Correlation of Boiling Heat Transfer, by S. Levy. (58—HT-8)

Heat Transfer to a Boiling Liquid—Mechanism and Correlations, by Kurt Engelberg-Forster and R. Greif. (58—HT-11)

Transient Heat Conduction in Elliptical Plates and Cylinders, by E. T. Kirkpatrick and W. F. Stokey. (58—HT-10)

Calculation of Transients in a Cross-Flow Heat Exchanger, by G. M. Dusinberre. (58—HT-5)

Free Convection, Forced Convection, and Acoustic Vibrations in a Constant Temperature Vertical Tube, by T. W. Jackson, W. B. Harrison, and W. C. Boteler. (58—HT-6)

Summary—Selected References on Gas Turbines, Regenerative Cycles, Rotary Regenerators, and Associated Heat-Exchange and Pressure-Drop Information, by W. E. Hammond.

Investigation of Heat Transfer, Flow, and Heat Exchangers as Related to Turbine Cooling, by H. H. Ellerbrock, Jr., and J. N. B. Livingood.

Progress and Development of Gas-Turbine Regenerators, by Sven Holm and R. L. Lyerly.

Heat Transfer and Friction for Fluids Flowing Over Surfaces at High Temperatures and High Velocities, by R. G. Deissler and A. L. Loeffler, Jr.

A New Technique for Measuring the Spectral Emissivity of Solids at High Temperatures, by P. E. Glaser and H. H. Blau, Jr. (58—AV-29)

ASME Papers Order Form

Pamphlet copies of numbered ASME technical papers are obtainable from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Please order only by paper number; otherwise orders will be returned. Papers are priced at 40 cents to members; 80 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons distributed annually to members, or coupons which may be purchased from the Society. Coupons, in lots of ten, are $3 to members; $6 to nonmembers.

Note: No digests are made of ASME papers published in full or condensed form in other sections of MECHANICAL ENGINEERING.

Copies of all ASME publications are on file in the Engineering Societies Library and are indexed by the Engineering Index, Inc., both at 29 West 39th Street, New York 18, N. Y.

ASME Transactions are on file in the main public libraries of large industrial cities and in the technical libraries of engineering colleges having ASME Student Sections.

ASME Order Department
29 W. 39th St.
New York 18, N. Y.

Date............

Please send me the papers indicated by the following circled numbers:

58—A-42
58—A-43
58—A-44
58—A-45
58—A-47
58—A-51
58—A-62
58—A-66
58—A-67
58—A-69
58—A-72
58—A-73
58—A-92
58—A-95
58—A-99
58—A-105
58—A-107
58—A-113
58—A-116
58—A-118
58—A-119
58—A-120
58—A-127
58—A-133
58—A-148
58—A-152
58—A-156
58—A-169
58—A-170
58—A-172
58—A-181
58—A-184
58—A-190
58—A-196
58—A-212
58—A-216
58—A-217
58—A-221
58—A-224
58—A-231
58—A-232
58—A-235
58—A-241
58—A-247
58—A-248
58—A-253
58—A-254
58—A-257
58—A-258
58—A-285
58—A-287
58—A-289
58—A-292
58—A-294

Name....................

Address....................

City..........State.........

☐Remittance enclosed ☐Bill me

☐ASME Mem. ☐Nonmem.

Includes Letters from Readers on Miscellaneous Subjects

COMMENTS ON PAPERS

Professionalism

To the Editor:

A LETTER by J. B. Nichols, published in the January, 1959, issue of MECHANICAL ENGINEERING, p. 102, recalled a number of letters which appeared in MECHANICAL ENGINEERING about 1918. These letters were written by recent graduates from engineering schools bemoaning the fact that superintendents and foremen received more money than graduate engineers. The deluge of letters ceased abruptly when a letter was published from Cyrus Townsend Brady, Jr., who was employed on an engineering project in Buenos Aires.

Mr. Brady volunteered that he had purchased a folding bed made in and shipped from Spain and, upon its arrival, Mr. Brady and one man worked an entire day assembling the parts thereof. Mr. Brady continued that the next day his wife decided to move the bed to another room so she and one maid disassembled it, moved it, and reassembled it. Total time, one and one half hours. Mr. Brady concluded his letter with: "Engineers are not so hot around our house now." This has been cited because:

Mr. Nichols has pointed out several reasons why so many young engineers feel they are not receiving the appreciation due them, although they have been taught in school, particularly in eastern schools, that when they receive their degrees they are the full-fledged article "than whom there are no whomer."

To the contrary, what they have learned in school are only fundamentals which can be applied to problems which arise, but the application must be based upon experience for which there is no substitute. Until experience has been acquired engineers should be humble as any other neophyte.

The modern engineer, in general, has two weaknesses:

He can prepare a paper to be read but he cannot talk extemporaneously with coherence and good diction; hence when he appears publicly he is outclassed by lawyers and politicians. This is not his fault but that of the school he attended because today there is too much written work and not enough oral. The schools have insufficient classrooms and instructors. This was mentioned by me to a friend who is a trustee of a well-known private university, with the result that in the last two years more and more oral work has been introduced into the courses.

Also, because of the demand for young engineers since the war, most young engineers are allocated to desk jobs. They do not get the practical experience from lying on their backs with their heads in dirt and grease while slugging up bolts. This is a great education.

Perhaps I'm sticking my neck out. If you publish this, at least we will have a good, old-fashioned argument which might help the young engineers who must succeed us old fossils.

I. L. Wise.[1]

---

[1] Consulting engineer, Chicago, Ill. Mem. ASME.

REVIEWS OF BOOKS

Industrial Hygiene and Toxicology

INDUSTRIAL HYGIENE AND TOXICOLOGY: Vol. 1, General Principles. Frank A. Patty, Editor. Interscience Publishers, Inc., New York, N. Y., Second Revised Edition, 1958. Cloth, 6 × $9^1/_2$ in., figs, tables, ref, index, xxviii and 830 pp., $17.50.

Reviewed by Frederick S. Mallette[1]

FORMERLY issued in two volumes, this well-known work is to be published in three separate parts with the following divisions: Volume 1—General Principles, Volume 2—Toxicology, Volume 3—Industrial Environmental Analysis.

Changes in the nature of problems faced by the industrial hygienist and in the environment which he safeguards have been met in the revised edition by the addition of new topics and amplification of the material presented earlier.

For example, the subject of noise is now believed to be of such importance that an extensive chapter has been assigned to its consideration.

So, too, the control of heat has come to receive a great deal of attention from industrial hygienists, particularly in those industries where high temperatures or radiant effects are a problem. In parts of four chapters, space is devoted to a discussion of several aspects of thermal technology.

For several reasons, but especially because of the similarity in the methods of investigation, the problem of air pollution control has entered the purview of the industrial hygienist. Furthermore, the careful control of indoor pollutants became doubly important because of their possible contamination of community atmospheres in the event of careless evacuation from industrial environments. A full chapter has been allotted to this subject.

Much more interest has been focussed in recent years on "human engineering" or the relationship of man to the machine.

---

[1] Executive secretary, ASME Committee on Air Pollution Controls.

Improper balance of all factors involved may result in health effects which will be within the scope of industrial hygiene. However, the principal discussion in this chapter relates to the control of the human factors concerned in industrial accidents.

Although the field of health physics has included in its scope the physiological effects of radiation, the widespread usage of radioactive material in industry has brought the potential health problems within the responsibility of many industrial hygienists. This book, therefore, will be of help to persons concerned with minor radiation exposures as well as to assist the health physicist in a consideration of other nonradiant hazards in the industrial environment.

Illumination and industrial sanitation are other new topics which overlap the field of industrial hygiene. In both fields, much new knowledge has been developed within the last decade.

An apparent effort has been made to produce a book useful to both the person with only a subsidiary interest in industrial health protection and to the experienced industrial hygienist who may be faced with new and unusual problems. To the former, a great deal of elementary material will be extremely useful; while to the latter, the new subject matter should be most helpful.

The book is well printed on good stock with an adequate number of illustrations. References are given in convenient footnotes and an exhaustive index has been appended.

BOOKS RECEIVED IN LIBRARY

Energy in Latin America
Prepared by the Secretariat of the United Nations Economic Commission for Latin America. 1957, Columbia University Press, New York, N. Y. 268 p., $8\frac{1}{2} \times 11$ in., paper. $2.50. Beginning with a statement of the problems involved, this study continues with recent developments in the consumption of energy. An analysis is made of the changes in consumption by forms of energy, the consumption of energy by economic sectors, energy resources, efficiency in the use of energy, and financial aspects. It concludes with the energy supply and demand prospects for 1965.

Engineering Vibrations With Applications to Structures and Machinery
By Lydik S. Jacobsen and Robert S. Ayre. 1958, McGraw-Hill Book Company, Inc., New York, N. Y. 564 p., $6 \times 9\frac{1}{4}$ in., bound. $10. Introduction to the analysis of technical vibrations of linear and nonlinear systems with particular emphasis on the transient state of motion. Classical analytical methods are used where feasible as are approximate methods, including the phase-plane graphical method for the solution of transient problems and the Ritz averaging method for solving steady-state nonlinear problems, and nonlinear relationships are introduced where possible.

Handbuch der Werkstoffprüfing
Vo. I: Prüf- und Messeinrichtungen. Edited by E. Siebel and N. Ludwig. Second edition. 1958, Springer-Verlag, Berlin, Germany. 890 p., 7×10 in., bound. 148.50 DM. Volume 1 of this five-volume "handbook" on materials testing covers a variety of topics. The first three sections describe the equipment and methods for tensile, impact, and fatigue testing. Succeeding sections deal with hardness testing, metallurgical laboratory practice, chemical analysis of metals, and spectrochemical analysis. Space is also devoted to deformation measurements, photoelastic investigations, radiographic and other nondestructive test methods, and to the testing of testing machines.

Heat Exchangers: Applications to Gas Turbines
By W. Hryniszak. 1958, Academic Press, Inc., New York, N. Y. 343 p., $6\frac{1}{4} \times 10$ in., bound. $10. Emphasizes design of heat-transfer units in connection with gas turbines, so as to obtain an economical unit for various applications. The design of recuperative heat exchangers, regenerators, and air preheaters is presented along with related aspects as test arrangements, stresses and materials, cost, and the question of weight in aircraft units.

How to Become a Professional Engineer
By John D. Constance. 1958, McGraw-Hill Book Company, Inc., New York, N. Y. 272 p., $5\frac{1}{2} \times 9\frac{1}{4}$ in., bound. $6.50. The underlying philosophy and practice of engineering is presented, and is followed by the practical steps to be taken in securing registered status: qualifying experience, how to prepare for and pass the written examination, and registration by endorsement. A summary of state registration laws, names, and addresses of state board secretaries, and a list of recommended texts for use in preparing for examinations are given.

Industrial Hygiene and Toxicology
Vol. I: General Principles. Edited by Frank A. Patty. Second edition. 1958, Interscience Publishers, Inc., New York, N. Y. 830 p., $6\frac{1}{2} \times 10$ in., bound. $17.50. An extensive treatise on industrial health. Revisions in this volume cover such areas as noise and its environmental implications, heat and its control, ionizing radiation exposures, and the inhalation and ingestion of radioactive gases and aerosols, human engineering and industrial safety, industrial sanitation, air pollution, and illumination.

Introduction to Nonlinear Analysis
By W. J. Cunningham. 1958, McGraw-Hill Book Company, Inc., New York, N. Y. 349 p., $6 \times 9\frac{1}{4}$ in., bound. $9.50. Discusses methods for obtaining solutions for nonlinear differential equations having a single independent variable. Numerical, graphical, and analytical methods are described, while many examples of physical systems are provided to illustrate the techniques of solution and the unusual types of phenomena which may arise. A knowledge of electrical circuits, mechanical circuits, and linear differential equations is required.

Introduction to Nuclear Engineering
By Richard Stephenson. Second edition. 1958, McGraw-Hill Book Company, Inc., New York, N. Y. 491 p., $6\frac{1}{4} \times 9\frac{1}{2}$ in., bound. $9.50. Major emphasis has been placed on those aspects of engineering practice unique to nuclear engineering. This edition contains two new chapters. The first deals with reactor-core design and discusses burnout, hot channel factors, and related problems. The second discusses thermonuclear reactions and the basic principles involved. A number of chapters have been expanded because of the declassification of literature in the field.

Liquid Metals and Solidification
Published 1958 by the American Society for Metals, Cleveland, Ohio. 348 p., $6 \times 9\frac{1}{4}$ in., bound. $7.50. Papers discussing: The theory and structure of liquids; transport properties in pure liquid metals; thermodynamics and properties of liquid solutions; nucleation in the solidification of metals; mechanism of growth; thermal considerations in freezing; redistribution of solute during freezing; imperfections resulting from freezing; polyphase solidification; structure of ingots and castings. The papers were presented at a seminar held during the 39th National Metal Congress and Exposition, Chicago, 1957.

Logic Machines and Diagrams
By Martin Gardner. 1958, McGraw-Hill Book Company, Inc., New York, N. Y. 157 p., $6 \times 9\frac{1}{4}$ in., bound. $5. A survey of mechanical and electrical machines designed to solve problems in formal logic. The Stanhope demonstrator, Jevon's logic machine, and the Marquand machine are described as are logic window cards for solving elementary logic problems. Applications of electrical logic machines to operations research and information storing and processing are discussed.

Mathematical Programming
By Nyles V. Reinfeld & William R. Vogel. 1958, Prentice-Hall, Inc., New York, N. Y. 274 p., $6 \times 9\frac{1}{4}$ in., bound. $9. Primarily designed for industrial personnel lacking advanced mathematical training, this volume stresses practical applications of mathematical programming. In addition to an extensive chapter consisting of case studies, material is presented on the distribution method, Vogel's approximation method, the simplex and its formulation, the relaxation method, and the computer as a means of solution.

Metals for Supersonic Aircraft and Missiles
Edited by D. W. Grobecker, 1958, American Society for Metals, Cleveland, Ohio. 423 p., $6 \times 9\frac{1}{4}$ in., bound. $7.50. This volume contains the Proceedings of the Conference, Heat Tolerant Metals for Aerodynamic Applications, January, 1957. The papers deal with materials-property requirements and test methods for aerodynamic applications; kinetics of oxidation in a gas stream; protective metallic coatings; the light metals; AISI and stainless steels for aerodynamic applications; nickel and cobalt base alloys; properties of eleven less common metals; fundamentals of metal-ceramic combinations; specific ceramics and cermets of promise.

Numerically Controlled Machine Tools—Implications for Management
By H. Clifton Morse and David M. Cox. 1958, Cox and Cox, Chicago Ill. 186 p., $8^{1}/_{2} \times 11$ in., paper. $25. Emphasizes management's role in planning for the use of numerically controlled machine tools. An over-all program for the introduction of these tools is outlined in relation to such aspects as productivity, profits, product pricing, cost controls, long-range planning, organizational structure, and management decisions.

Operational Mathematics
By Ruel V. Churchill. Second edition. 1958, McGraw-Hill Book Company, Inc., New York, N. Y. 337 p., $6 \times 9^{1}/_{4}$ in., bound. $7. The operational properties of the Laplace transformation are developed in considerable detail. This is followed by the operational mathematics for various Fourier transformations and their generalizations, as well as by the theory and applications of eigenvalue problems. Applications are illustrated through problems in engineering and physics involving differential equations, such as vibrating mechanical systems, electric circuits, and servomechanisms.

Pumps, Fans, and Compressors
By A. de Kovats and G. Desmur. 1958, Blackie and Son Ltd., Glasgow, Scotland. 327 p., $6^{1}/_{4} \times 9^{1}/_{4}$ in., bound. 45s. A discussion of the phenomena of flow and of energy transformations is presented prior to the problem of design and construction which comprises the main portion of the volume. Rather than relying on mathematical formulas the authors have stressed experimental results as a basis for the calculation of dimensions for centrifugal and axial-flow fans, pumps, and compressors for various operational requirements. Translated from the original French edition published in 1953.

The Solid State for Engineers
By Maurice J. Sinnott. 1958, John Wiley & Sons, Inc., New York, N. Y. 522 p., $6 \times 9^{1}/_{4}$ in., bound. $12.50. Intended to acquaint engineers with the basic principles underlying the behavior of solid materials. Aspects discussed are crystallography; thermodynamic stability of solid structures and rates of change between states; types of solids: metallic, ionic, covalent and molecular; elastic and plastic deformation; mechanical properties of solids; electron and zone theories; electronic conduction, semiconduction, and insulation phenomena; optical properties of solids.

Solid State Physics
Supplement 1: Nuclear Quadrupole Resonance Spectroscopy. By T. P. Das and E. L. Hahn. 1958, Academic Press, Inc., New York, N. Y. 233 p., $6 \times 9^{1}/_{4}$ in., bound. $7. Emphasizes pure nuclear quadrupole interactions with crystalline and molecular electric fields, while placing magnetic interactions in a minor role. Part one deals with the phenomenological theory for the frequencies of the quadrupole spectra, the nature of their Zeeman patterns, the line shapes and line widths, and the relaxation times. Part two deals with the experimental apparatus required, and part three is concerned with interpretation of experimental results.

Space Flight
By Carsbie C. Adams. 1958, McGraw-Hill Book Company, Inc., New York, N. Y. 373 p., $5^{1}/_{2} \times 8^{1}/_{4}$ in., bound. $6.50. A clearly written account of the past and present status of space travel. The first half of the volume is devoted to a historical review and to the astronomical and engineering fundamentals of astronautics. The latter half is concerned with the problems to be faced in the future such as the human and biological factors of space flying, communications, and navigation.

LIBRARY SERVICES

Engineering Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

A Survey of Journal Bearing Literature
By Dudley D. Fuller. 1958, American Society of Lubrication Engineers, Chicago, Ill. 260 p., $6^{1}/_{4} \times 9^{1}/_{4}$ in., bound. $15. Contains approximately 2500 references with abstracts covering the period from the earliest known literature to 1954. The abstracts attempt to outline the scope, conclusions, and general significance of the material included in the reference cited. In addition to the alphabetical listing, a review of the significant literature on the basis of subject matter is included and provides an over-all perspective with regard to the analysis, design, performance, and maintenance of journal bearings.

Symposium on Nondestructive Tests in the Field of Nuclear Energy
Published 1958 as Special Technical Publication No. 223 by the American Society for Testing Materials, Philadelphia, Pa. 395 p., $6 \times 9^{1}/_{4}$ in., bound. $10. Surveys ultrasonic, radiation, and eddy current methods and techniques. The majority of the papers included discuss applications in the inspection of castings, tubing, unclad fuel element components, and clad-fuel elements.

Symposium on Radiation Effects on Materials. Vol. 2
Published 1958 as Special Technical Publication No. 220, by the American Society for Testing Materials, Philadelphia, Pa. 137 p., $6^{1}/_{4} \times 9^{1}/_{4}$ in., bound. $3.75. Twelve papers dealing with the interpretation of existing code and specification values as they apply to nuclear reactor structures and components. Two deal with consideration of radiation effects in design, five with radiation facilities and techniques, and five with various materials.

Technical Editing
Edited by B. H. Weil. 1958, Reinhold Publishing Corp., New York, N. Y. 278 p., $5^{1}/_{4} \times 7^{1}/_{2}$ in., bound. $5.75. Presents the basic concepts and practices of internal communications, journal editing, book publishing, and graphic arts as related to the technical field.

Transistor Technology: Vol. II
Edited by F. J. Biondi. 1958, D. Van Nostrand Company, Inc., Princeton, N. J. 701 p., $6 \times 9^{1}/_{4}$ in., bound. $17.50. Part one discusses the technology of materials with special emphasis on silicon. Part two deals with the principles of device design beginning with diodes, and continuing with triodes, and the more complex multiple junction switching devices and tetrodes. Chapters follow on radiation sensitive devices, field effect devices, and on noise behavior. The book concludes with the design implications of surface phenomena.

Administration of Salaries and Intangible Rewards for Engineers and Scientists
By John W. Riegel. 1958, Publications Distribution Service, University of Michigan, Ann Arbor, Mich. 105 p, 84 p. $6 \times 9^{1}/_{4}$ in., bound. $6. Two surveys bound in one volume, devoted to the needs, goals, and job satisfaction of engineers and scientists. Specific aspects investigated are job activities, actions of immediate supervisors, salaries, intangible rewards, working relations with associates, company assistance to professional development, attitudes toward collective bargaining, and the administration of technical programs. The surveys are Reports numbers 8 and 9 of The University of Michigan Bureau of Industrial Relations.

Advances in Petroleum Chemistry and Refining, Vol. I
Edited by Kenneth A. Kobe and John J. McKetta, Jr., 1958, Interscience Publishers, Inc., New York, N. Y. 641 p., $6 \times 9^{1}/_{4}$ in., bound. $13.50. The first of a series intended to co-ordinate and report on the many phases of research in the petroleum industry. Contains sections on unit operations and design, including separation and purification by crystallization, superfractionation, azeotropic and extractive distillations, and new fractionating-tray designs; refining processes, including alkylation of paraffins, catalytic reforming, and solvent refining; petrochemicals, including the oxo process and solid polymers from surface catalysts; mechanical equipment.

Aerodynamics of Supersonic Flight
By Alan Pope. Second Edition. 1958, Pitman Publishing Corp., New York, N. Y. 243 p., $6 \times 9^{1}/_{4}$ in., bound. $3.55. Covers flow in a duct, two-dimensional flow, the oblique shock, approximate theories, supersonic wind tunnels, three dimensional flow, and performance calculations. This new edition contains additional material on the aerodynamic theory and the design of a simple supersonic wind tunnel as well as various revisions throughout the text.

Analysis and Control of Nonlinear Systems
By Y. H. Ku. 1958, Ronald Press Company, New York, N. Y. 360 p., $6 \times 9^{1}/_{4}$ in., bound. $10. This book is intended to provide electrical and mechanical engineers, physicists, and applied mathematicians with a practical account of available techniques for dealing with nonlinear vibrations and oscillations. Both analytical and topological methods of solution are presented; electrical-mechanical analogs are explained for reciprocal solutions; systems with many degrees of freedom are discussed; and the analysis is extended to cover feedback systems with nonlinearities.

Digital Techniques for Computation and Control
By Martin L. Klein and others. 1958, Instruments Publishing Company, Inc., Pittsburgh, Pa. 394 p., $5^{3}/_{4} \times 8^{1}/_{2}$ in., bound. $6. A survey of the basic techniques used for digital computation and control, including code arithmetic, logical networks, multiplexing, conversion, data reduction, digital process control, two-terminal relay circuits, counting techniques, digital computers of all types, computer programming, digital differential analyzers, and combined analog-digital equipments. Descriptions of components and available commercial equipments add to the book.

Current Engineering: Events, News, and Comment

E. S. NEWMAN
News Editor

THE ROUNDUP

Solid Nuclear Fuel Elements Topic of First International Symposium

Scientists and engineers discuss findings from several different approaches

MORE THAN 500 nuclear scientists and engineers from the United States and 18 foreign countries participated in the First International Symposium on Nuclear Fuel Elements, New York, N. Y., Jan. 28 and 29, 1959, sponsored jointly by Columbia University and Sylvania-Corning Nuclear Corporation.

Seventy researchers and technological authorities in this field representing 18 other nations and nearly 450 Americans attended the two-day conference held in Columbia's McMillin Theatre.

All 18 papers were invited for this first large-scale conference exclusively devoted to solid nuclear fuel elements. The report of progress since the Geneva conference proved ample justification.

The Symposium was arranged by a committee which included Maxwell Gensamer and George L. Kehl, of Columbia University's School of Mines, Stanley G. Roboff and Leonard Smiley, of Sylcor, and Henry H. Hausner, consultant on fuel-element technology. Dr. Hausner was toastmaster at the dinner on Wednesday evening at which W. K. Davis, Mem. ASME, formerly director of the Reactor Division of the AEC and now vice-president of the Bechtel Corporation, spoke on "Fuels for the Reactors of the Future."

Several approaches are being taken to improve fuel-element performance, according to the panel of speakers.

The Specialists Say:

One is to increase the temperature at which the reactor is operated, which automatically increases the efficiency of the whole system. A. Boettcher, of Degussa, the German builder of atomic reactors, in Frankfurt-am Main, discussed the use of uranium monocarbide fuel elements, which would permit reactors to be operated at considerably higher temperatures than at present—in the neighborhood of 2000 C. A. Strasser, of Nuclear Development Corporation of America, White Plains, N. Y., gave the American point of view on this problem and reported on high-temperature fuel elements already developed or being developed. He pointed out the requirements imposed by high temperatures on cladding materials, fuel-matrix materials, and the metals and nonmetallic materials that are available currently. O. J. C. Runnals, of Atomic Energy of Canada, Ltd., reviewed the possibilities of achieving an economic fuel element based on uranium dioxide—presently the most commonly used fissionable material. Leon Green, Assoc. Mem. ASME, of Aerojet-General Nucleonics, set forth the possibilities of uranium-carbon combinations. French production of uranium-carbide cermets by a pressure-sintering method were described by R. Caillat, of the French Commissariat à l'Énergie Atomique.

Standardization Sought

A second approach is to vary the shape or configuration of the fuel element. Stanley Roboff, of Sylvania-Corning Nuclear Corporation, explained the economies which standardization of fuel-element design would permit. It was the general opinion of those attending the Symposium that it is no longer too early for standardization. This could be a major factor in lowering the cost of the fuel cycle. Sylcor intends to seek such standardization vigorously.

J. Cunningham of Oak Ridge National Laboratory, reviewed progress that is being made in plate-type elements. W. A. Maxwell, formerly chief metallurgist of The Martin Company's Nuclear Division and now with General Nuclear Engineering Corporation, balanced the structural advantages of tubular elements and greater heat-transfer area against the difficulties of fabricating them and the inability to contain large volumes of fuel material. He concluded that fabricating and testing techniques for tubular elements are further advanced than the art of building these elements into complete assemblies. Some stimulating ideas on the design of fuel elements with larger surface areas, to improve heat-transfer properties, were included in a paper by H. K. Hardy, chief metallurgist of the United Kingdom Atomic Energy Authority, read by another UKAEA representative in Dr. Hardy's absence due to illness.

A third general approach is the use of other fissionable materials than uranium—notably plutonium. Results thus far attained in this area in the U. S., Canada, and the U. K., were reported by R. E. Tate, of Los Alamos Scientific Laboratory of the AEC.

View shows a section of the large audience attending the first International Symposium on Nuclear Fuel Elements sponsored jointly by Columbia University and Sylvania-Corning Nuclear Corporation, in Columbia's McMillin Theatre, New York City, January 28 and 29

At the first International Symposium on Nuclear Fuel Elements dinner, W. K. Davis discusses fuels for reactors of the future. In the background, *left to right,* are M. Eisenbud, J. R. Dunning, and L. L. Davenport.

A fourth approach is improvement of the present widely used metallic-uranium elements. F. Foote, of Argonne National Laboratory, discussed the opportunities open to uranium and uranium-alloy elements. C. C. Woolsey, of Atomics International, a division of North American Aviation, Inc., pointed out that thorium-uranium elements were attractive for use in high-temperature reactors because they provided a "breeding" reaction, allowed higher maximum temperatures, had a reasonably long life, and could be fabricated at costs comparable to those for other fuel materials. B. de Lasteyrie, of CERCA (Cie pour L'Etude et la Réalisation de Combustibles Atomiques), gave an interesting insight into the development and production of metallic fuels in France, dwelling at length on the third loading of the French EL-3 Reactor.

J. F. Schumar, of Argonne National Laboratory, covered a wide variety of fabrication techniques for fuel elements which are being applied in the U. S. The use of −325-mesh particle-size elemental silicon powder in a picture-frame roll-bonding technique for the ALPR was one process described. Under 1000 to 2000 psi with press-mounted dies maintained above 577 C, the hard sharp grains of the silicon powder perforate the oxide film on the Al and establish an oxide-free Al to interface with re-oxidation prevented by the pressure exclusion of oxygen. Other reactions lead to formation of a liquid alloy and oxide which are forced out of the joint. Another unusual technique was the use of liquid-metal bonding in an EBR-II fuel element intended for remote-controlled reprocessing. "Uncapping" the element drains the liquid sodium leaving the material to be reprocessed.

R. B. Gordon, of Atomics International, presented a careful study of the engineering approach to the matter of getting low-cost fabricating and reprocessing techniques, by evaluating all of the various possibilities.

Still another approach being followed is the use of elements which combine the functions of fuel and moderator. Ulrich Merten, of General Atomics Division of General Dynamics Corporation, discussed this approach. He reported on a new type of uranium-zirconium-hydride element, which tests indicate is capable of increased reactivity without the occurrence of boiling in the reactor core. This is possible because of the negative temperature coefficient which is an inherent characteristic of these fuel-moderator combinations.

Finally, the conference took a close look at the behavior of all types of fuel elements with respect to irradiation and corrosion. J. E. Draley, of Argonne National Laboratory, reviewed the methods which have been tied for combatting corrosion problems in water-cooled reactors. Specifically, he treated the alloying of the fuel elements with zirconium, niobium, molybdenum, and silicon, and the use of aluminum, zirconium, and stainless steels for cladding and structural materials. L. W. Kates, of Sylvania-Corning Nuclear Corporation, reported the findings of extensive observations of the various kinds of radiation damage. Strengthening the cladding is indicated in many cases to overcome the forces which cause dimensional changes to the core. Alloying of core and cladding materials is also helpful. Higher-temperature operation may reduce some of the effects of radiation by annealing out some of the structural defects.

Among the many authorities from foreign countries who participated in the discussion of these subjects were: R. Kiessling, chief metallurgist of Atomenergi, AB., Stockholm, Sweden; Vladimir Shmelev, a Russian, presently first officer of the Reactor Division of the International Atomic Energy Agency, Vienna, Austria; Wladyslaw Krawczyk, chief of the metallurgical division of the Polish Government's Office of Nuclear Energy, Warsaw; Seishi Kikuchi, commissioner of Japan's AEC, Tokyo; Sakichi Goto, professor of Tokyo University; Alberto Cacciari, chief metallurgist of the Comitato Nazionale Ricerche Nucleari, Milan, Italy; Rui Pacheo de Figueiredo, physicist with La Junta de Energía Nuclear, Lisbon, Portugal; and Mario Bancora, director of the Technical Supply Division of the International Atomic Energy Agency.

The Symposium was opened on Wednesday morning by M. Eisenbud, manager of the New York Operations Office of the U. S. AEC. J. R. Dunning, Mem. ASME, dean of Columbia's School of Engineering, greeted the conferees, pointing out that any and all co-operation between universities and industry makes for more rapid development. Lee L. Davenport, president of Sylvania-Corning Nuclear Corporation, stressed that a constant exchange of ideas in symposium-type conferences was greatly needed if economical nuclear power was to be achieved, and in order to bring about the improvement of standards, engineering, and production methods.

ASME Has a Leading Role in 1959 American Power Conference

DIRECT conversion of heat to electricity will be among many topics concerned with the electric-power and related industries to be discussed at the 21st annual American Power Conference to be held at the Hotel Sherman, Chicago, Ill., March 31 through April 2.

Other topics to be considered during the 26-session technical program include papers on electrical heating as it is applied to commercial, industrial, and residential projects; nuclear power plants; review of policies affecting the nation's hydroelectric resources; extra high-voltage systems; fuels; and industrial power plants which will be given increased emphasis.

The conference is conducted with the co-operation of a group of 14 colleges and universities and nine professional engineering societies, including The American Society of Mechanical Engineers.

Sessions of most interest to mechanical engineers have been selected from the tentative program, and are as follows:

▶TUESDAY, MARCH 31

Registration 9:00 a.m.

Opening Meeting 10:00 a.m.

Chairman: *Dudley Sanford*, executive vice-president, Union Elec. Co., St. Louis, Mo.

Co-Chairman: *W. A. Lewis*, professor of electrical engineering, Illinois Inst. of Tech.

Invocation: *The Rev. William D. Faughnam*, Chaplain, Illinois Inst. of Tech.

Education for Management in a Technological World, by *W. F. Rockwell, Jr.*, Rockwell Mfg. Co., Pittsburgh, Pa.

Integration of Engineering and Financial Planning of Electric Power Systems, by *Murray Joslin,* Commonwealth Edison Co., Chicago, Ill.

Joint APC-ASME Luncheon 12:15 p.m. Sponsored by ASME

Chairman: *Glenn B. Warren,* President, ASME

Co-Chairman: *M. W. Maxwell,* chairman, ASME Chicago Section

Speaker: *J. E. Corette,* president, Edison Elec. Inst., and president and general manager, The Montana Power Co., Butte, Mont.

Steam Turbines 2:00 p.m. Sponsored by ASME

Chairman: *Vern Stone,* manager of production, Commonwealth Edison Co., Chicago, Ill.

Co-Chairman: *C. D. Campbell,* consulting engineer, Westinghouse Elec. Corp., Philadelphia, Pa.

Ultrasonic Testing of Large Steam-Turbine Parts, by *M. L. Smith,* TVA, Knoxville, Tenn.

Progress in Steam-Turbine Generator Research and Development, by *J. W. Stotts,* and *J. K. Dixon,* Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Large Steam-Turbine Generators for the 60's, by *E. H. Miller* and *B. M. Cain,* Gen. Elec. Co., Schenectady, N. Y.

Advance Development in Component Design for Large Steam Turbines, by *R. Reese,* Westinghouse Elec. Corp., Philadelphia, Pa.

Water Technology 1—Ion Exchange 2:00–5:00 p.m.

Chairman: *L. F. Wirth, Jr.,* manager, Ion Exchange Division, National Aluminate Corp., Chicago, Ill.

Co-Chairman: *J. W. Wilkes,* director of Research and Development, Dearborn Chemical Co., Chicago, Ill.

Two-Bed Primary System Solves Mixed-Bed Demineralizer Problems, by *H. C. Farmer,* Philadelphia Elec. Co., Philadelphia, Pa.

Experience With an Improved Intermediate-Base Anion Exchange Water for Problem Waters, by *I. M. Abrams, R. J. Cooley,* and *G. F. Stoneman,* Chemical Process Co., Redwood City, Calif.

Filtration of Condensate as a Part of the High-Rate Condensate Scavaging Process, by *W. H. Homer* and *V. J. Calise,* Graver Water Conditioning Co., Philadelphia, Pa.

High-Flow Rate Ion Exchange, by *Joe Thompson* and *A. C. Reents,* Illinois Water Treatment Co., Rockford, Ill.

Fuels. Sponsored by Fuels Division of ASME 2:00–5:00 p.m.

Chairman: *James R. Jones,* combustion engineer, Peabody Coal Co., Chicago, Ill.

Co-Chairman: *Edward M. Marselli,* plant superintendent, Electric Energy, Inc., Joppa, Ill.

Evaluation of Coal-Sampling Procedures, by *W. W. Anderson,* Commercial Testing and Engineering Co., Chicago, Ill.

Producing Lightweight Aggregate from Molten Boiler Slag, by *H. L. McNally,* Dow Chemical Co., Midland, Mich.

Generating Station Coal-Bunker Explosions, by *W. W. Hagnauer,* Commonwealth Edison Co., Chicago, Ill., and *K. W. Hamming,* Sargent & Lundy, Chicago, Ill.

Evening General Interest Session 8:00 p.m.

Long-Range Goals for the Generation of Electric Flow

Devoted to present thinking and future prospects for direct conversion of heat into electrical energy and for achieving electric power from fusion. Following presentation of papers, discussion and questions from the audience will be welcome.

Chairman: *Andrew W. Kramer,* editor of atomics, *Power Engineering,* Barrington, Ill.

Co-Chairman: *Perry L. Blackshear, Jr.,* Univ. of Minnesota, Minneapolis, Minn.

Direct Conversion of Heat to Electric Power—Its Present Status and Future Prospects, by *C. R. Kelly, Jr.,* Westinghouse Res. Lab., Pittsburgh, Pa.

Thermonuclear Fusion Research for Power, by *L. J. Linde,* C. Stellarator Associates of Allis-Chalmers and RCA, Princeton, N. J.

Discussion.

▶WEDNESDAY, APRIL 1

Symposium: Once-Through Boiler Plants for Subcritical Pressure 9:00 a.m.

Chairman: *Ben G. Elliott,* chairman, department of mechanical engineering, Univ. of Wisconsin

Co-Chairman: *Reno C. King,* associate professor of mechanical engineering, New York Univ.

Design and Operating Characteristics of Steam-Generating Equipment, by *Elno Powell,* Combustion Engineering, Inc., New York, N. Y.

Operating Experiences at Portland Station, by *J. G. Miller,* Metropolitan Edison Co., New York, N. Y.

Operation and Water Conditioning a Unit No. 4 Tait Station, by *J. D. Williamson,* and *R. F. Andres,* Dayton Power and Light Co., Dayton, Ohio.

An Integrated Combustion Control System, by *E. D. Scutt,* Leeds & Northrup Co., Philadelphia, Pa.

Hydroelectric Power 1 9:00 a.m.

The Nation's Hydro Resources—Review of Policies

Chairman: *A. J. Ackerman,* consulting engineer and president, Hydroelectric Planners, Madison, Wis.

Co-Chairman: *Prof. A. T. Lenz,* chairman, civil-engineering department, University of Wisconsin, Madison, Wis.

The Federal Power Commission—Licensing Procedures and Regulations Under the Federal Power Commission, Washington, D. C.

Example of Hydroelectric Development by a Private Utility, by *H. N. Henry,* Alabama Power Co., Birmingham, Ala.

Policies in Cost Estimating, Earnings Analysis, and Financing, by *P. P. Stathas,* Duff and Phelps, Inc., Chicago, Ill.

Water Technology—Analytical and Control 9:00 a.m.

Chairman: *S. F. Whirl,* chief chemical operating engineer, Duquesne Light Co., Pittsburgh, Pa.

Co-Chairman: *W. R. Homan,* chief chemist, Commonwealth Edison Co., Chicago, Ill.

A New Method for Continuous Analysis of Dissolved Oxygen and Water, by *J. M. Wright* and *W. T. Lindsay, Jr.,* Wettis Atomic Power Division, Pittsburgh, Pa.

A New System for the Completely Automatic Chemical Analysis of Boiler and Condensate Waters and Power Plants. (Authors to be announced).

Water Technology 3—Condenser Tubing Alloys 10:30 a.m.

Chairman: *T. J. Hodan,* sales manager, Heat-Transfer Department, Water Conditioning Products, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Stainless-Steel Condenser Tubes—Four Years' Experience, by *J. C. Cokley, Jr.,* Alloy Tube Division, Carpenter Steel Co., Union, N. J.

Experience With Aluminum Condenser Tubes. (Author to be announced.)

Central Station Power Plants 2:00 p.m.

Chairman: *H. L. Solberg,* assistant dean of engineering, Purdue Univ., Lafayette, Ind.

Co-Chairman: *Francis Seyfarth,* Univ. of Illinois, Urbana, Ill.

The Second Year's Operation of a Supercritical Unit, by *T. T. Frankenberg, A. G. Lloyd,* and *E. B. Morris,* American Elec. Power Service Corp., New York, N. Y.

The Evaluation of Automation for Central Station Power Plants, by *F. A. Ritchings* and *W. A. Summers,* Ebasco Services, Inc., New York, N. Y.

Which Enclosure Shall It Be? by *C. D. Birget* and *J. H. Kline,* Commonwealth Associates, Inc., Jackson, Mich.

Water Technology 4 2:00 p.m.

Chairman: *M. D. Baker,* chairman, ASME Joint Research Committee on Boiler Feedwater Studies, and chief chemist, West Penn Power Co., Springdale, Pa.

Co-Chairman: *Selden K. Adkins,* manager, Consulting Service, National Aluminate Corp., Chicago, Ill.

Stress Corrosion of Stainless Steel and Boiler-Water Treatment, Shippingport Atomic Power Station, by *W. J. Singley, I. H. Wellinsky,* Bettis Atomic Power Division, Westinghouse Elec. Corp., and *S. F. Whirl,* Duquesne Light Co., Pittsburgh, Pa.

Discussion

All Engineers Dinner 6:30 p.m.

Presiding: *Philip Sporn,* president, American Electric Power Co., New York, N. Y.

Speaker: *Herbert D. Vogel,* chairman of the board, TVA, Knoxville, Tenn.

Subject: **Engineers Must Do Better.**

▶THURSDAY, APRIL 2

Steam Generators. Sponsored by ASME Power Division 9:00 a.m.

Chairman: *Alf Kolflat,* senior partner, Sargent & Lundy, Engineers, Chicago, Ill.

Co-Chairman: *T. S. Fetter,* executive engineer, engineering department, Philadelphia Electric Co., Philadelphia, Pa.

An Operating Report of the Monitored Sterlington Station, by *Donald Aswell,* Louisiana Power and Light Co., Westwego, La., and *George Parmakian,* Riley Stoker Co., Worcester, Mass.

Control System for Achieving Optimum Boiler Economy in a Single-Unit Simultaneously Burning Three By-Product Fuels, by *W. O. Barnett,* Fairless Works, Fairless Hills, Pa.

Gas Recirculation and Its Relation to Boiler Design and Operation, by *J. D. Andrews, A. M. Frendberg,* and *P. H. Koch,* The Babcock & Wilcox Co., Barberton, Ohio

Mechanics of Corrosion in High-Temperature Superheater and Reheater Tubes, by *E. M. Marselli,* Electric Energy Corp., Joppa, Ill., and *R. C. Ulmer,* Combustion Engineering, Inc., New York, N. Y.

Industrial Plants 1 9:00 a.m.

Co-Chairman: *A. D. Holland,* professor of mechanical engineering, Georgia Inst. of Tech., Atlanta, Ga.

An Industry Viewpoint, by *R. W. Precious,* Union Carbide Olefins Co., South Charleston, W. Va.

An Industry Viewpoint, by *R. H. Emery,* St. Regis Paper Co., Jacksonville, Fla.

A Turbine Manufacturer's Viewpoint, by *M. E. Ferson,* Gen. Elec. Co., West Lynn, Mass.

A Boiler Manufacturer's Viewpoint, by *C. E. Miller,* Combustion Engineering, Inc., New York, N. Y.

A Consulting Engineer's Viewpoint, by *J. A. Donald,* Sargent & Lundy, Engineers, Chicago, Ill.

Peaking Service 9:00 a.m.

Chairman: *T. E. Guhman,* assistant superintendent of generating plants, Union Electric Co., St. Louis, Mo.

Co-Chairman: *Severin Raynor,* professor of mechanical engineering, Northwestern Univ., Evanston, Ill.

Automatic Plants for Peaking, by *E. W. Kettering, B. B. Brownell,* and *B. H. Hefner,* Electromotive Division, General Motors Corp., LaGrange, Ill.

Design Concepts of a Low-Cost Gas-Turbine-Generating Plant for Peak Load Service, by *A. O. White* and *R. J. Carpenter,* Gen. Elec. Co., Schenectady, N. Y.

Nuclear Power Plants 1 10:30 a.m.

Chairman: *Roy M. Casper,* general manager, Nuclear Power Division, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Co-Chairman: *Alan H. Stenning,* department of nuclear engineering, M.I.T., Cambridge, Mass.

Power-Reactor Safeguards, by *R. H. Shannon,* United Engineers and Constructors, Inc., Philadelphia, Pa.

A Design Code for Power Reactors, by *D. B. Singer,* Armour Res. Foundation, Chicago, Ill.

Nuclear Power Plants 2 2:00 p.m.

Chairman: *Bernard I. Spinrad,* division director, Reactor Engineering Division, Argonne Nat. Lab., Lemont, Ill.

Pebble Bed Reactor, by *S. T. Robinson* and *R. F. Benenati,* Sanderson and Porter, New York, N. Y.

Industrial Development of Boiling-Water Reactors for the Generation of Competitive Nuclear Power, by *R. B. Richards,* Gen. Elec. Co., San Jose, Calif.

150-MW Organic Moderated Reactor Power Plant, by *Ralph Balent,* Atomics International, Canoga Park, Calif.

Industrial Plants 2 2:00 p.m.

Sponsored by the National Association of Power Engineers

Chairman: *Ivan J. Cronkhite*, president, National Association of Power Engineers.

Co-Chairman: *Donald J. Renwick*, associate professor of mechanical engineering, Michigan State Univ., East Lansing, Mich.

The Economics of Air Preheat on Industrial Boilers, by *C. L. Brown*, The Air Preheater Corp., New York, N. Y.

New Developments in Fuel-Burning Equipment for Industrial Boilers, by *A. W. Jackson*, The Babcock & Wilcox Co., Barberton, Ohio

Solving Maintenance Problems

Paper by *K. R. Hodges*, Sears Roebuck & Company, Chicago, Ill.

Panel Discussion: Questions submitted by audience

Panel Members:

M. Berg, Allied Valve Renewal Co., Chicago, Ill.

M. B. Golber, Armour and Co., Chicago, Ill.

L. J. Cohan, Combustion Engineering, Inc., New York, N. Y.

L. J. Dawson, Ingersoll Rand Co., New York, N. Y.

S. E. Sparks, Viscosity Oil Co., Chicago, Ill.

W. R. Jacobs, Westinghouse Elec. Corp., Chicago, Ill.

Feedwater Circuit 2:00 p.m.

Chairman: *Roy Sahlstrom*, Faville Le Vally Corp., Chicago, Ill.

Co-Chairman: *Sidney Mayster*, Sargent & Lundy Engineers, Chicago, Ill.

Thermal Density Currents and Their Utilization in Condensing Water Design, by *Rex Elder*, TVA, Knoxville, Tenn.

Velocity Versus Pipe Size in Feedwater Systems, by *L. H. Carr*, Edward Valves, Inc., subsidiary of Rockwell Mfg. Co., East Chicago, Ind.

Condenser Arrangement for Dumping Large Quantities of Steam, by *R. A. Wilson*, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Electric Space Heating 2:00 p.m.

Chairman: *Ole A. Hill, Jr.*, marketing supervisor, Commercial-Industrial, Commonwealth Edison Co., Chicago, Ill.

Co-Chairman: *Donald H. Madsen*, associate professor of mechanical engineering, State Univ. of Iowa, Iowa City, Iowa

Experiences With Commercial and Industrial Heating With Electricity, by *G. G. Freyder*, Commonwealth Edison Co., Chicago, Ill.

Residential Electric Heating, by *J. H. K. Shannahan*, American Electric Power Service Corp., New York, N. Y.

PEOPLE

Honors and Awards. Carl F. Kayan, Mem. ASME, received the "Great Teacher Award" of the Columbia University Society of Older Graduates. Recipient of a similar award with him was Polykarp Kusch, professor of physics and 1955 Nobel Prize winner.

Clyde Williams, Hon. Mem. ASME, has been named recipient of the James Douglas Gold Medal of the AIME. The medal recognizes distinguished achievement in nonferrous metallurgy, including both beneficiation of ores and alloying and utilization of nonferrous metals.

The late Charles F. Kettering, Fellow ASME, and 1940 ASME Medallist, was posthumously awarded the 1958 Edison Medal of the AIEE. Ghaffar Farman-Farmaian, consulting engineer, Teheran, Iran, received the society's 1958 Alfred Noble Prize Paper Award.

Charles Tenney, vice-president, Southern Illinois University, Carbondale, Ill., addresses the newly formed Paducah Group, ASME, at its first meeting. Seen in photo, *left to right,* are: T. R. DuBois, former chairman, St. Louis Section; E. M. Marselli, chairman of the Paducah Group; Dr. Tenney; and Ralph Gallington, chairman, S.I.U.'s Applied Science Department.

Charles S. Draper, Fellow ASME, has been named an Honorary Fellow of the Institute of the Aeronautical Sciences. The award was also presented to Sir George Edwards, managing director, Vickers Armstrong, Ltd.

Karl O. Elderkin, Bowaters Research and Development, Inc., is the twenty-seventh TAPPI Medallist. The medal is awarded by the Technical Association of the Pulp and Paper Industry for outstanding contributions toward technical advancement of the industry.

Frederick Krug, Mem. ASME, has received the 1959 Gano Dunn Award of The Cooper Union Alumni Association.

Westinghouse Electric Corporations' Transformer Division was presented with a Certificate of Award by the National Noise Abatement Council. The award was in recognition of research and its application on the reduction of noise in electric power transformers.

New Officers. Enoch R. Needles has been re-elected president of Engineers Joint Council for 1959. Augustus B. Kinzel, vice-president for research, Union Carbide Corporation, was elected vice-president. Other officers of EJC include E. Paul Lange, secretary; L. K. Wheelock, assistant secretary; and E. L. Chandler, treasurer.

Walker L. Cisler, Fellow ASME, has been elected president of the Thomas Alva Edison Foundation, Inc., succeeding the late Charles F. Kettering. Mr. Cisler announced the election of Eugene W. Kettering as a vice-president and trustee, and of Thomas W. Martin as trustee.

George S. Richardson, senior partner, Richardson, Gordon and Associates, Consulting Engineers, Pittsburgh, Pa., has been elected president of the American Institute of Consulting Engineers.

Fred C. Sutro, Jr., Spencer Chemical Company, Kansas City, Mo., has been elected national president of the Society of Plastics Engineers, Inc. Jules W. Lindau, III, Mem. ASME, was elected second vice-president.

Leslie J. Hooper, Mem. ASME, has been appointed by the U. S. National Committee of the International Electrotechnical Commission as chairman of the Technical Advisory Committee responsible for United States participation in Technical Committee No. 4 activities covering Hydraulic Turbines; Theodore M. Robie, TC No. 19 on Internal-Combustion Engines.

R. Dixon Speas, Mem. ASME, is among a group of new members named to the Council of the Institute of the Aeronautical Sciences at the group's annual meeting in New York recently.

Donald W. Darnell, Mem. ASME, was elected vice-president of the National Constructors Association. W. R. Wood, president, Girdler Construction Division, Chemetron Corporation, Louisville, Ky., was elected president.

Campus Data. Roy H. Cook has been appointed dean of Pratt Institute's School of Engineering, Robert Fisher Oxnam, president of the Institute has announced.

George Town has been named dean of the Division of Engineering at Iowa State College.

Joseph Modrey, Mem. ASME, will undertake a study aimed at the improvement of teaching methods in the field of machine design. Granted a leave of absence from his teaching duties at Union College, Schenectady, N. Y., Professor Modrey will carry out his studies at M.I.T., RPI, Purdue, and Columbia Universities, and the University of Calif.

Morrough P. O'Brien, Mem. ASME, will retire on June 30, 1959, from his post as dean of the college of engineering at the University of California, Berkeley.

New Appointments. Joseph W. Barker, past-president ASME, was elected churchwarden by the vestry of the parish of Trinity Church, New York, N. Y.

R. A. Baker, Mem. ASME, succeeds F. P. Fairchild, Fellow ASME, as chief engineer for Public Service Electric and Gas Company, Newark, N. J. Mr. Fairchild has been with the utility company for almost 30 years.

Ernest Hartford, former ASME consultant, who retired after 48 years of service to the Society, is currrently doing the promotion work for the Engineering Index, Inc.

Midwestern Conference on Fluid and Solid Mechanics at University of Texas; ASME a Cosponsor

Announcement was made by Dr. W. W. Hagerty, Mem. ASME, Dean, College of Engineering, The University of Texas, that the Midwestern Conference on Fluid and Solid Mechanics will be held on the Austin campus on Sept. 9–11, 1959. This meeting, which will be the Sixth Conference on Fluid Mechanics and the Fourth Conference on Solid Mechanics, forms another element in the series held in the midwestern region of the United States. Previous conferences, at approximately two-year intervals, have been held at the Universities of Illinois, Ohio State, Minnesota, Purdue, and Michigan.

Although the Conferences are held on a regional basis, there are no restrictions on attendance or on the residence of authors of technical papers. A General Conference Committee for handling initial arrangements is composed of Dr. Walter L. Moore, professor of civil engineering; Dr. Enrico G. Volterra, Mem. ASME, professor of engineering mechanics; and Dr. Milton J. Thompson, Fellow ASME, professor of aeronautical engineering. Abstracts and titles of papers should be submitted to Professor Thompson, the chairman, before April 1, 1959. Complete manuscripts will be required by June 1, 1959, in order to make possible the distribution of the Proceedings at the opening of the Conference. Inquiries concerning other details of the Conference also should be addressed to Professor Thompson.

The University of Texas, as a part of its support of the Conference, has arranged for a series of invited lectures on important aspects of mechanics. Dr. Samuel A. Schaaf of the University of California will present a lecture on "Recent Progress in Rarefied Gas Dynamics Research"; Dr. Lloyd H. Donnell, Mem. ASME, Illinois Institute of Technology, on "New Developments in Shell Theory." At a dinner meeting, Dr. Sydney Goldstein of Harvard University will discuss "Recent Progress in Applied Mechanics."

Arrangements are being made for entertainment programs for conferees and their guests. Tours of University laboratories and a visit to the Southwest Research Institute in San Antonio also are being planned.

A number of technical societies and research organizations have joined with The University of Texas in cosponsoring the Midwestern Conference. These include the American Institute of Chemical Engineers, the American Mathematical Society, the American Meteorological Society, the American Physical Society, the American Institute of Physics, the American Society of Civil Engineers, The American Society of Mechanical Engineers, the Institute of the Aeronautical Sciences, the Society for Experimental Stress Analysis, the Society of Petroleum Engineers, the Office of Scientific Research of the Air Force, the Office of Naval Research, the Office of Ordnance Research of the Army, and the National Science Foundation.

A Call for Papers—National Automatic Control Conference

Technical papers are being solicited now for the 1959 National Automatic Control Conference to be sponsored by the Institute of Radio Engineers Professional Group on Automatic Control, with official participation by The American Society of Mechanical Engineers Instruments and Regulators Division, the American Institute of Electrical Engineers, the Instrument Society of America, and the IRE Professional Group on Industrial Electronics. The conference will be held Nov. 4–6, 1959, at the Sheraton Hotel, Dallas, Texas.

Before the deadline of June 1, 1959, four copies of summaries should be submitted to the Technical Program Chairman, Mr. G. S. Axelby, Westinghouse Electric Corporation, Box 746, Baltimore 3, Md. In order to facilitate selection of papers, the 1000 to 1500-word summary must:

1. State clearly what has been accomplished.
2. Indicate (*a*) whether the material is primarily theoretical or experimental; (*b*) whether practical applications are included; and (*c*) whether the paper is believed to be an original contribution or an extension of an earlier paper.
3. Include a pertinent bibliography.

Accepted papers will be published.

EDUCATION

Educating for the Future

Newark College of Engineering is offering a weekly lecture series, "Senior Convocations for 1959," conducted by its department of Personnel Relations. The series will cover five general areas, each of which will stress the importance of graduates being interested in fields other than their own. They are: labor-management relations, professional engineering, civic problems, graduate study, and Alumni Association participation.

The series is part of NCE's four-year program of orientation to industry and society which was conceived several years ago by the college's first president, the late Allan R. Cullimore, Mem. ASME, in co-operation with Roy V. Wright, then president of The American Society of Mechanical Engineers; and Arthur T. Vanderbilt, chief justice of the New Jersey Supreme Court.

Dr. Emanuel Stein, chairman of New York University's department of economics, was the first of 15 speakers to participate in the program. His subject was "Labor."

Nonspecialization at Stevens

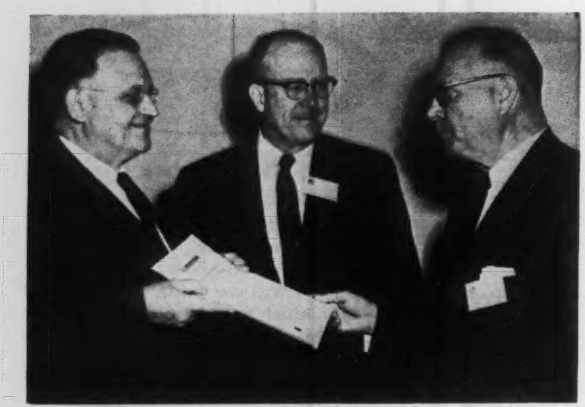
Thirty-three students at Stevens Institute of Technology this semester entered a new curriculum in the physical sciences.

The first group to enroll in this program, the undergraduates will take basic courses in mathematics, chemistry, and physics as well as in some of the engineering sciences, and then pursue advanced work in such areas as physical chemistry, atomic physics, and differential equations. In addition, they will devote a good portion of their time to the study of history, literature, philosophy, and the like, under the Department of Humanities.

The new science program carries on the philosophy of nonspecialization underlying its sister engineering curriculum. Science students will be prepared to enter industry to follow a career in mathematics, chemistry, or physics, or to continue their studies in graduate school. The new curriculum leads to the degree of Bachelor of Science.

Science Honors Program

The Columbia University School of Engineering's new program of college-level science courses for gifted high-



B. R. Teare, *left,* dean of engineering and science, Carnegie Institute of Technology, and J. A. Hutcheson, *center,* Mem. ASME, Westinghouse Electric Corporation, receive, on behalf of their respective institutions, a citation from EJC President, E. R. Needles. The citation recognizes the 20th anniversary of the establishment of the George Westinghouse Scholarship Program.

A Westinghouse Electric Corporation senior engineer for materials and standards explains the photographic process involved in the printed circuit laboratory to a visiting science teacher. Science teachers from schools in the area of the firm's Baltimore Division spent a day seeing how scientists and engineers solve daily problems by applying basic concepts taught in the classroom.

school students, inaugurated last fall, has met with such signal success that school authorities hope to expand it next September.

The Science Honors Program brought 158 outstanding 12 to 18-year-old students to the Columbia campus on Saturdays for the first term of the 1958–1959 academic year. Each week the 26 girls and 132 boys chosen from public and private secondary schools in New York City, Long Island, Westchester County, Connecticut, and New Jersey have received instruction in the most recent developments in highly sophisticated areas of science.

The Columbia faculty members who teach the classes are leading scientists, including Professor Theodosius Dobzhansky, pioneer of modern genetics; Professor Ernest Nagel, authority on scientific logic; and Professor Robert I. Bernstein, one of the creators of the revolutionary ORDIR radar.

At the end of the Saturday morning classes, the students lunch at the Faculty Club, where they talk over their scientific goals and interests with such Columbia authorities as Nobel Prize physicists Polykarp Kusch and Tsung-Dao Lee, and famed anthropologist Margaret Mead.

ASEE-ASTM Symposium

Today's engineering students, already burdened with heavy schedules, must learn more than ever before about the materials they will use. Reactors, rockets, and space vehicles impose severe new environments; and reliability must be sharply increased.

How can engineering materials be better taught to engineering students—becomes a vital question.

To explore the situation, two of the nation's societies most concerned with this problem, the American Society for Engineering Education and the American Society for Testing Materials, will sponsor jointly a symposium on Education in Materials at the ASTM Annual Meeting in Atlantic City, June 22–26, 1959.

Numerical Control Conference

The Effect of Numerically Controlled Machines on Engineering, Production, and Management Philosophy is the subject of a conference being planned and conducted jointly by the engineering schools of the University of California at Los Angeles and Purdue University. The conference is scheduled for March 22 and 25 at UCLA, and from April 7 to 10 at Purdue. For further information write: James B. Ball, Assistant to the Dean of Engineering, Purdue University, Lafayette, Ind.

Summer Courses

Case Institute of Technology. A one-week course on modern techniques in the use of strain gages will be offered from June 22 to 26. Tuition is $175 and covers all instructional and laboratory fees, books, supplies, and five luncheons. Send requests for applications to Dr. James R. Hooper, Jr., Director of Special Programs, Case Institute of Technology, Cleveland 6, Ohio.

University of Michigan. Over 20 intensive one and two-week conferences are being planned by the University of Michigan for Summer 1959. Courses from technical writing to topics in the design of digital computing machines are designed for practicing engineers and scientists. Deadline date for registrations is April 15. For further information, write R. E. Carroll, Co-ordinator of Engineering Summer Conferences, University of Michigan, Ann Arbor, Mich.

New York University. The metallurgical engineering department of the College of Engineering will present four programs intended primarily for practicing engineers during the summer of 1959:

"Thermoelectric Materials," to be given the week of June 15, will include a series of lectures designed to inform engineers of the latest theory and materials in the field and the newest devices based on thermoelectric effects.

"Ductile Iron," to be given the week of June 29, will consist of lectures and panel discussions on the technology of ductile-iron materials.

"Vacuum Metallurgy," two-day conference on June 1 and 2.

"Titanium Metallurgy," two-day conference on September 14 and 15.

Tuition for the one-week courses is $110; and registration fee for each of the conferences is $10.

North Carolina State College. The Institute of Statistics will sponsor a one-week course in statistics methods for research workers in industry and the physical sciences beginning the week of August 10. Course will be held at Brevard College, Brevard, N. C. Registration fee is $125, and enrollment will be limited to 50 students. For further information and bulletins, write The Division of College Extension, Box 5125, State College Station, Raleigh, N. C.

The Pennsylvania State University. A diversified program of seminars for engineers and scientists will be conducted this summer; the schedule follows:

"Seminar on Reactors and Radioisotopes," June 1 to 26.

"Electrical Contacts Seminar," June 7 to 12.

"Machinability Seminar," June 7 to 12.

"Underwater Missile Engineering Seminar," June 7 to 19.

"Electrical Precipitation Seminar," June 14 to 19.

"Plastics Seminar," June 28 to July 3.

"Research and Development Management Development Seminar," July 5 to 10.

"Report Writing Seminar," September 14 to 25.

Inquiries concerning these programs should be directed to Engineering Seminars, Extension Conference Center, The Pennsylvania State University, University Park, Pa.

Purdue University. A ten-day course on the Design of Experiments for statisticians, quality control personnel, engineers, and others in industry who are concerned with planning and interpreting the results of industrial experiments will be offered for the first time this summer.

Concurrently with the above course, an advanced course in Quality Control will also be given.

Further information may be obtained from Prof. Charles R. Hicks (Design of Experiments), or Prof. Irving W. Burr (Quality Control), Engineering Administration Building, Purdue University, Lafayette, Ind.

Training Reactors

University of Florida. The Atomic Energy Commission has announced proposed issuance of a license to the Univeristy of Florida at Gainesville for operation of a low-power teaching reactor. General Nuclear Engineering Corporation, Dunedin, Fla., designed and is prime contractor for the Argonaut-type reactor.

University of Kansas. A tank-type nuclear training reactor will be built by the Research Laboratories Division of Bendix Aviation Corporation for the University of Kansas.

Rice Institute. The facility to be purchased by the Houston, Texas, institution is a small research reactor equipped with a thermal column and designed by the manufacturer, Aerojet-General Nucleonics, San Ramon, Calif.

Strain Gage Techniques

A short course in Strain Gage Techniques will be held in San Antonio, Texas, March 30 through April 3, under the joint sponsorship of the Society for Experimental Stress Analysis and Southwest Research Institute.

The meeting will cover such topics as basic theory of wire-resistance strain gage, details of gage characteristics, temperature effects in strain gages, mechanical and electrical aspects of the gage system, electric circuits for strain gages, and the like.

Tuition for the course is $175 payable by March 23. All inquiries should be addressed to Dr. M. M. Lemcoe, Southwest Research Institute, Box 2296, San Antonio 6, Texas.

Army Closed-Circuit TV

The world's largest military closed-circuit educational television system was placed in operation recently by the U. S. Army Signal School.

Signal School officials formally accepted the newly expanded seven-channel system, which employs Radio Corporation of America television cameras for both live and film programming, associated studio equipment, and 468 receivers bringing instruction courses and other training material to a student body of 6000 men.

Inauguration of this system marks a major milestone in the growth of educational television, military and otherwise.

MEETINGS OF OTHER SOCIETIES

March 16–20

American Society for Metals, 11th western metal exposition and congress, Ambassador Hotel, Los Angeles, Calif.

April 5–9

Edison Electric Institute, annual convention, New Orleans, La.

April 6–10

American Welding Society, annual convention and welding show, Hotel Sherman and International Amphitheatre, Chicago, Ill.

May 11–14

The Institute of Fuel, major developments in liquid fuel firing 1948–1959, Torquay, Devon, England.

May 25–29

The Institution of Electrical Engineers, international convention on transistors and associated semiconductor devices, Savoy Place, London, England.

(For ASME Coming Events, see page 127)

Graduate Student Opportunities

The College of Engineering and Science at the Carnegie Institute of Technology has announced a number of opportunities for graduate students. Teaching assistantships, graduate fellowships, and research assistantships, for the academic year 1959–1960, are open in the fields of chemical, civil, electrical, mechanical, and metallurgical engineering, and in chemistry, physics, and mathematics.

For further information, write Robert F. Mehl, Dean, Office of Graduate Studies, Carnegie Institute of Technology, Schenley Park, Pittsburgh 13, Pa.

LITERATURE

Water-Treatment Practices

"Russian and Eastern European Water-Treatment Practices," by V. J. Calise, Mem. ASME, and W. A. Homer, is now available at no charge. The 14-page paper surveys the literature and incorporates information from visitors to Russia and from Russian authorities in this field.

For further information, write R. S. Lewis, Graver Water Conditioning Company, 216 West 14th Street, New York 11, N. Y.

Petroleum Equipment

The Association of French Manufacturers of Equipment for the Petroleum Industry has published a new edition of their official directory. The catalog presents technical descriptions of material available from manufacturers, specifications, data, and the like. A special section shows an alphabetic index of members of the association, a classified list of materials (with English translations) with reference to fabricators, a repertory of patents, licenses, and trade-marks, an English-French glossary of common technical terms used in the oil industry, and a series of conversion tables of American, British, and metric units. The 492-page book costs 2500 French francs or about $5.

Proceedings

Manpower Utilization. The Proceedings of The Delaware Valley Conference on "Effective Utilization of Scientists and Engineers" are now available. The "How-to-do-it" conference, sponsored by industries, educational institutions, and professional societies of the Delaware Valley, was under the auspices of the President's Committee on Scientists and Engineers. Copies are $2 and may be obtained from the Public Relations Office, Drexel Institute of Technology, Philadelphia 4, Pa.

Space Technology. An informal colloquium of scientists and engineers has been formed for the discussion of lunar and planetary exploration, and its members have made available in collected form their early thinking on the subject.

"The Proceedings of the Lunar and Planetary Exploration Colloquium" is published by courtesy of the Missile Division, North American Aviation, Inc., and requests for further information may be directed to that firm. Such subjects as: the chemistry of the moon, power for a lunar colony, and where to land on the moon were treated in a recent issue.

Materials and Methods. Proceedings are now available of two short courses on recent developments in important fields of mechanics and materials at The Pennsylvania State University. Entitled "Materials Engineering Design for High Temperatures," and "Mechanical Properties of Materials," copies cost $9.50 and $8.50, respectively. Order copies from J. Marin, Department of Engineering Mechanics, The Pennsylvania State University, University Park, Pa.

Russian Translations

- One of Russia's leading technical journals, ***Stanki i Instrument***, is being translated and published under the title *Machines and Tooling*. The Production Engineering Research Association, Melton Mowbray, Leicestershire, England, published the first issue in January of this year.

Machines and Tooling covers research and development in the field of production as well as improvements in equipment and methods. Annual subscription rate, outside the United Kingdom, is about $12.

- The National Science Foundation has recently compiled a list of Russian scientific journals available in English translation. The Foundation indicated that there are now in print 53 English editions of Russian journals, four extensive series of translated Russian abstracts of scientific papers, and four series of partial translations of important Russian journals. The list of journals may be obtained from the Office of Scientific Information, National Science Foundation, Washington 25, D. C.

New Cobalt Journal

The Cobalt Information Center has announced the availability of a new illustrated quarterly review, ***Cobalt***. The journal will be published in French and English.

It will present articles of general interest, articles on varied uses of cobalt and its alloys, reports on cobalt research and development, abstracts of current literature, and news of interest to cobalt users. Interested persons may obtain a copy of the first issue by addressing requests on company letterhead to the Cobalt Information Center, c/o Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio.

Annual Reports

ASME. The Annual Report of The American Society of Mechanical Engineers is currently available. The report covers the activities of the Society for the fiscal year Oct. 1, 1957, to Sept. 30, 1958. Copies may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

ECPD. The Twenty-Sixth Annual Report of the Engineers' Council for Professional Development is available at a cost of $1 from ECPD, 29 West 39th Street, New York 18, N. Y. Reports of ECPD's committees, among them: Education and accreditation, student development, and recognition, reports of constituent organization representatives; and the year's high lights are included.

IES Lighting Handbook

Publication in March of a completely new third edition of the IES "Lighting Handbook" has been announced by the Illuminating Engineering Society. Cost of the 1100-page book is $10. Further details are obtainable from Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Nuclear Energy

A series of 12 "Reports on the Productive Uses of Nuclear Energy" has recently been completed by the National Planning Association. Included in the group are studies of economic requirements and economic growth; nuclear power development in Brazil, Israel, India, Italy, Japan, Pakistan, and Puerto Rico; nuclear energy and world fuel prices; and nuclear process heat in industry.

The paper-bound booklets range in price from $1 to $3. Further information is available from the National Planning Association, 1606 New Hampshire Avenue, N. W., Washington 9, D. C.

Welding Symbols

The first major change in welding symbols in recent years has been announced by the American Welding Society. The new "Standard Welding Symbols" has been prepared by the AWS Committee on Nomenclature, Definitions, and Symbols, and is published by the American Welding Society.

The new symbols include: spot and seam welds made by arc welding; welds used in aircraft, guided missile, and automotive work; and types of welds used in structural steel fabrication, reinforced concrete work, and the like.

The 87-page standard costs $3, and may be purchased from Department T, American Welding Society, 33 West 39th Street, New York 18, N. Y.

Human Factors—New Journal

Human Factors is the new journal of The Human Factors Society of America. The journal publishes original articles dealing with man in relation to machine and environmental factors in all their ramifications.

Membership in the society includes subscription to the journal. Individual subscriptions, however, may be had for $10 a year.

Write: Human Factors Society of America, Box 24032, Los Angeles 24, Calif., to the attention of John Lyman, Managing Editor.

Thermoplastics Handbook

"Processing of Thermoplastic Materials" is a definitive handbook covering all aspects of thermoplastics processing. Engineering problems involved in extrusion, injection molding, calendering, and other thermoplastics processing operations are covered. Nineteen technical authorities have contributed to this volume, and 14 plastics firms and universities have supported it by providing information, editors, and authors.

Volume II in the Society of Plastics Engineers Plastics Engineering Series, the 752-page volume is available at $14.40 to SPE members, and $18 to nonmembers. Write: Society of Plastics Engineers, Inc., 65 Prospect Street, Stamford, Conn.

In photo, *right,* one sees the United Nations building through what remains of the last structure on the site of the new United Engineering Center

In photo, *below,* is the UEC site as it looked just hours before it was completely cleared. It takes little imagination to see UEC in this location—but it will take many more contributions.

United Engineering Center

Have You Made Your CONTRIBUTION?

Contributions to the Member Gifts Campaign to build the new United Engineering Center are tax deductible.

A letter from the U. S. Treasury Department, Internal Revenue Service, to United Engineering Trustees, Inc., dated Aug. 14, 1957, states, "Contributions made to you are deductible by the donors in computing their taxable net income in the manner and to the extent provided by Section 170 (*b*)(1) and (2) of the 1954 Code."

If you have not been approached for a contribution, call your Section chairman now!

ASME Member Gifts for United Engineering Center

The American Society of Mechanical Engineers now has passed the halfway mark in obtaining gifts from members for the United Engineering Center. As of Jan. 23, 1959, 50.5 per cent of our quota had been pledged by 17.1 per cent of our members. Commenting on the latest report, Dr. W. F. Ryan, chairman of the ASME Member Gifts Committee, called attention to the tremendous contrast in the reports from individual Sections.

Section	Per Cent Giving
Olean	56.9
Northwest Florida	54.2
West Virginia	53.8
Cincinnati	51.9
Canton-Alliance-Massillon	45.9
Nebraska	45.9
Fort Wayne	45.6
Waterbury	43.3
Hudson-Mohawk	41.6
Central Illinois	36.7
Central Indiana	35.9
Iowa-Illinois	35.9
Mid-Hudson	34.5
Southern Tier	33.2
Worcester	32.9
San Diego	32.1
Milwaukee	30.8
Minnesota	30.7
Hawaii	30.0
Erie	29.3
Inland Empire	29.1
Birmingham	28.5
Anthracite-Lehigh Valley	28.3
Baltimore	28.1
Westmoreland	27.9
Chicago	27.5
Arizona	27.1
New London	26.9
Western Massachusetts	26.9
Columbus	25.5
Pittsburgh	25.5
Rock River Valley	25.1
Dayton	24.6
Western Washington	23.7
Providence	22.8
St. Louis	22.3
Rochester	21.8
Central Iowa	21.5
Central Kansas	20.4
Piedmont-Carolina	19.7
Detroit	19.6
New Mexico	19.3
Fairfield County	18.8
Sabine	18.8
Central Savannah River Area	18.4
Atlanta	18.0
Savannah	16.8
Mid-Jersey	16.5
Boston	15.5
South Texas	15.4
Central Pennsylvania	15.3
Cleveland	15.0
Metropolitan	13.7
San Francisco	12.5
Mid-Continent	12.3
Akron	12.2
Rocky Mountain	11.7
Syracuse	10.7
Utah	10.4
Ontario	10.3
Philadelphia	9.9
Louisville	9.4
Greenville	9.2
Oregon	8.6
Los Angeles	7.6
North Texas	5.6
New Orleans	5.5
St. Joseph Valley	5.4
East Tennessee	4.6
Eastern N. C.	4.4
Washington, D.C.	4.1
Chattanooga	3.2
Delaware	3.1
Buffalo	2.8
Virginia	2.3
New Haven	2.2
Toledo	1.7
Youngstown	1.4
Miami	1.3
Hartford	1.0
Columbia Basin	0.8
Kansas City	0.8
Northern New England	0.4
Florida	0.0
Mexico	0.0
Susquehanna	0.0

Is Your Section a Leader?

It is apparent from the returns that those Sections which have made substantial personal contacts have gone over the top. Only eight Sections have exceeded their quotas. They are: Waterbury with 181.7 per cent; Cincinnati, 152.0 per cent; Canton-Alliance-Massillon, 140.9 per cent; Dayton, 139.5 per cent; Atlanta, 119.3 per cent; Hudson-Mohawk, 107.5 per cent; Olean, 102.8 per cent; West Virginia, 101.4 per cent; and Northwest Florida has reached 97 per cent of its quota.

The accompanying table lists the percentage of members pledged, up to January 23, by Sections.

Notes on
Society Activities
and Events

E. S. NEWMAN
News Editor

THE ASME NEWS

Sixth ASME Technology Executives Conference . . .

. . . *Probes Divisions, Publications, Meetings, Research Problems*

A HIGH TIDE of interest in technical matters in ASME Sections as well as in the other activities of the Society was one of the major points of discussion at the Technology Executives Conference, Arden House, Harriman, N. Y., February 8–10, 1959.

Main purpose of these conferences is the indoctrination of the incoming chairman and the new member of the executive committee of each Professional Division of ASME to guide them in carrying out the policies and aims of the Society. In addition, the conference serves as a forum to discuss some of the problems relating to the activities under the Board on Technology, including Professional Divisions, Meetings, Publications, and Research.

All but two of the Regional Vice-Presidents, several Council members, the Board on Technology, representatives of all Divisions but two, as well as Publications, Meetings, and Research Committee representatives, and Staff personnel attended and participated in the informal sessions.

Opening Session

Co-chairman R. C. Allen welcomed those attending the sixth of these annual conferences.

He stated that: "Engineering has taken a new look in which leadership in technology—where the sciences, engineering, and economics are blended into an inseparable picture—has become an essential bulwark of internatonal democracy. Never before has the membership of our Society had before it such great opportunities and at the same time such great responsibilities."

Following a general description of the organization of the Society and its activities by ASME Secretary O. B. Schier, II, who stressed the increasing percentage of associate members in the Society's total membership, D. H. Cornell, member of the Board on Technology and past chairman of the Professional Divisions Committee, described the twelve-member Board on Technology whose delegation of authority from Council covers such primary activities as publications, meetings, and research. He mentioned the new Technical Development Committee established to examine the areas of expanding technology and suggest ways in which the Society should meet the challenges they present.

Codes and Standards

W. P. Kliment described the Board on Codes and Standards as "charged with the logical application of technology in everyday use," accomplished by the systematic formulation of Codes and Standards by qualified personnel. He emphasized the need for solicitation of participation by specific individuals not only for national but international activities. Since 1945, 23 new nations with about 600 million people have become independent. In addition to these nations, primarily in the underdeveloped category, there are perhaps another 20 underdeveloped nations of older standing with 500 million people. All of these billion or more people are eager to raise living standards.

The ASME acts as an administrative sponsor to many ASA Standards and Codes, and the ASA is currently participating in 44 projects of the 93 which the ISO has under way and holds the secretariat on eight of these. The committees and subcommittees of the IEC exceed 80 and the U. S. has been active in all but five.

President's Introduction

ASME President G. B. Warren spoke on the need for interaction between the Professional Divisions and the Regions and Sections. The real creativity in mechanical engineering has to come from the Divisions and should be on a planned basis.

The needs and the way they can be met must be visualized and the proper individual reached. It is important that more of the ASME Research Committee findings be published, President Warren stated.

He spoke of a number of areas of current engineering development in which ASME should consider taking an interest. (Portions of President Warren's address will be featured in a forthcoming issue of MECHANICAL ENGINEERING.)

Co-Chairman R. G. Folsom characterized President Warren's remarks as a "keynote address," setting the background for the Technology Executives Conference.

ASME Research Program

"Technological matters which transcend competitive problems" are the province of the ASME Research Program, it was stated by John H. Hitchcock, chairman of the Research Executive Committee. Primarily concerned with "basic nonproprietary information," the stimulus comes from engineers who seek guidance on advanced phases of engineering. Research proposals are referred to existing

Allen

Schier

Cornell

Kliment

Warren

Folsom

committees, or new committees are set up when necessary. The appropriate Division is considered the top authority on need, competence, and personnel. The Division also supplies a critical review of progress in its field. See "ASME's Research Committee Program," MECHANICAL ENGINEERING, February, 1959, page 48.

Publication Policies and Procedures

John de S. Coutinho, chairman of the Publications Committee, stated that the Society's public standing and prestige rises and falls principally with the quality of its publications.

Publications. In ten years the number of papers and pages in Transactions has doubled, and the number of technical specialties has increased greatly.

It has become impractical to publish all of this material in one publication. Hence the subdivision of the Transactions of the ASME into five quarterlies: *Journal of Engineering for Power*, *Journal of Basic Engineering*, *Journal of Applied Mechanics*, *Journal of Heat Transfer*, and *Journal of Engineering for Industry*.

It is hoped that this new plan will greatly increase the utility and circulation of Transactions, and make each of these quarterlies more of a service journal.

MECHANICAL ENGINEERING is the one publication that goes to every member of the Society. It is not only our show window but has a great potential for creating a following. It represents a great organizational force and provides an effective tool for molding and developing the spirit and morale of the membership.

The third principal type of publication is the pamphlet. Distribution of individual papers seems to be the most flexible solution to the problem of meeting the broad interests of our members, involving the least waste, and providing each member with just what he needs. Pamphlets have been redesigned and improved with an eye to making them the final form of publication for the bulk of papers. Experiments are being made in distribution procedures, and in publishing conference proceedings and other special packages of papers when practical.

Deadlines represent the greatest area of conflict between the Publications Committee and the Divisions. When a paper misses a deadline, the Publications Committee is in trouble. One hundred, or approximately 25 per cent of the 1958 Annual Meeting papers, were received after the last deadline (four weeks), and half of them had been recommended for publication.

Mr. Coutinho believes that more unsolicited papers should be encouraged. The quality is usually better since the review procedure is more stringent. Solicited papers are the cause of much of the deadline trouble. There is a hesitancy about asking authors of solicited papers to comply with the rules, although they can usually be convinced if the value of publication—tied to the need for meeting deadlines—is stressed.

Review of papers is, of course, a major key to quality, and good reviews take time. The Applied Mechanics Division, whose paper quality is exceptionally high, operates solely on unsolicited papers, averages four months for a review, and rejects about 50 per cent of the papers submitted. Quality of papers is extremely important to the maintenance of Society standards.

The Publications Committee has revised the review form to encourage the reviewer to state his opinion in his own words, and to add comments and corrections. Mr. Coutinho appealed to all Divisions for a tighter review procedure.

The Publications Committee is trying to make its services available to all Divisions and Research Committees without favoritism, and, therefore, has had to establish certain traffic rules, Mr. Coutinho concluded.

Meetings

W. B. Wilkins, chairman of the Meetings Committee, outlined some of the considerations of that committee. The Honors Lectures Subcommittee is being completely revised. Headed by a Meetings Committee member, it will have representatives of the Civic Affairs Committee, Honors Committee of the Management Division, and the Lectureship Committee.

A new preprint box has been designed to hold complete sets of the papers for a technical session, and includes a change box and attendance cards. Attendees will be encouraged to take a copy of each paper, and either buy or return it at the end of the session. At last year's Aviation Conference, where there were too many papers to give a complete set to each registrant, another experiment was tried. Each person received a choice of eight free papers as part of his registration fee.

Deadlines, already discussed by the Publications Committee, also are being considered by the Meetings Committe. A possible rule: Deny permission to anyone to go to the podium and present a paper whose manuscript was not in the hands of the Staff four weeks before the meeting; 90 days before if the paper is considered of permanent interest. Further, it is felt that any program-making agency which does not have a complete list of authors and titles of papers in the hands of the Staff by June 1, for the 1959 Annual Meeting should have its session rescheduled at a future meeting. This deadline allows 60 days for advising the author that a paper should be written, and two or three weeks for review.

The preparation of an advance and a final program in place of the former single program for Division Conferences should do much to stimulate interest and encourage better attendance at these conferences. Advance programs can be mailed approximately 9 weeks before the conference.

When later asked about feedback on Annual Meeting programming information from Headquarters, ASME Secretary O. B. Schier, II, pointed out that the mimeographed program sheets which come out in August go back to all Divisions. These indicate the preliminary status of the program, providing an opportunity to check omissions and overlaps. All technical sessions and luncheons are included, but not committee meetings. These may then be scheduled to avoid as many conflicts as possible.

The revised ASME Manual MS-2 "Meetings and Conferences" and new program planning deadline schedules for 1959 meetings and conferences were the basis of further discussion.

Professional Divisions

R. Tom Sawyer, chairman of the Professional Divisions Executive Committee, served as chairman of an open discussion on Professional Divisions operations. He presented a certificate of appreciation to R. G. Folsom for his services on the PDEC.

The committee, under the direction of the Board on Technology, organizes, fosters, and co-ordinates the activities of the Professional Divisions and Groups of the Society (a detailed list of these functions is given on p. 4 of ASME Manual MS-11, "Professional Divisions Manual," and statements of the scope of each of the Professional Divisions appear in this issue of MECHANICAL ENGINEERING, pp. 66-76).

The maintenance of a continuing policy with rotating personnel was discussed, and it was pointed out that there are two means: (*a*) Personnel are moved through the various responsibilities before they serve as chairmen; (*b*) past-chairmen

Hitchcock

Wilkins

Coutinho

Sawyer

Rowley

Allardt

serve on the advisory committees after their terms expire.

Closer ties between Divisions and Research and Codes and Standards-making activities were recommended. It was suggested that at least one research session be included in each Division Conference.

Division Conferences were considered at different sessions in various contexts. In 1959, 21 of the 24 Divisions—all except Process Industries, Rubber and Plastics, and Safety—will be holding at least one Division Conference. Under the old pattern of four general meetings a year, total attendance was less than 10,000. More than 10,000 now attend the Division Conferences alone.

In addition, with the discontinuance of the Spring and Fall Meetings and the growing interest in the Division Conferences, the individual member has to cover only three meetings each year instead of four. He is also better able to concentrate in the field of his specialty in the Division Conference.

How to Present a Technical Paper

L. N. Rowley, a Director of ASME, spoke on Monday evening on "Tuning-in With Your Technical Audience." Beginning with a series of caricatures of authors with poor presentations, he emphasized that the successful transmission of ideas is the basis of a good technical session. Clarity and simplicity are paramount. Short words and short sentences are better than long ones, and statements should be direct, with active verbs. Papers should not be read, but a shorter speaking version prepared—"the mind can't absorb what the fanny can't endure."

A sharp eye on the pace of presentation—the rate that one idea follows another—is important, and transitions or changes in subject or drift of ideas need to be signaled. If your ideas are put on cards and read and reread—but not memorized—you will deliver the speech easily with the comforting assurance that you have it there on the cards if you forget. Above all, speak loudly and clearly, and put yourself into the presentation; if you don't show any interest, how can you expect the audience to?

Section-Division Integration

E. W. Allardt, vice-president of Region V, introduced the subject of Section-Division Integration. The regional vice-presidents, particularly a committee composed of E. W. Allardt, Henry S. Aurand, aud Arthur W. Weber, have discussed the dissatisfaction of many members with what they consider a lack of communication between the Division and Section organizations. Many members are unable to attend the national Division Conferences and would like more technical papers presented in Section meetings. There seems to be much ignorance of the way in which these could be programmed, and how advice could be obtained from the Divisions.

To meet this need, the vice-presidents have suggested the formation of Regional and Sectional Professional Division Interest (or Liaison) Committees. Section committees would have three members. Regional committees would have one representative for each Section in the Region. The eight regional chairmen would become members of a Professional Division Interest Committee of the Board on Technology or be allied in some other manner considered by the Board.

There was some feeling that this would create an unnecessarily elaborate organization, although there was great need for closer co-operation. Some Sections are almost inactive, and their existing organization should be able to undertake this activity.

Mead Bradner, a member of a five-man ad hoc Technical Interest Committee established by the Board on Technology presented some of the ideas of that committee. Ronald B. Smith, chairman of the committee, elaborated on them. Eugene W. Jacobson explained the operations of a Professional Divisions Interest Committee already established in Region V, which has representatives of each of the 15 Sections in that Region.

The work of the committee is largely a matter of publicity at this time. Lists of those in Region V preparing technical papers for presentation at general or Division Conferences are sent to Sections for use in local newsletters, and as a source of papers for local meetings.

Region III has a Professional Division Liaison Committee.

Section Professional Divisions, although not specifically provided for in the Constitution or By-Laws, already exist in some Sections and should help to meet much of this need. Los Angeles has 9, Philadelphia 15, and Dallas and a number of other Sections also have them. The West Coast finds a particular need for them since transportation difficulties limit regional representation on Professional Division committees and make it difficult to attend conferences.

Senior Assistant Secretary T. A. Marshall, Jr., suggested that the Professional Divisions Executive Committee could help the Sections organize Division activities. ASME President Warren asked for greater horizontal communication between the Sections and Divisions.

Much of the problem will be solved when it is possible to analyze Society membership records readily in different ways, and machine processing is contemplated for the new building. ASME Secretary O. B. Schier, II asked that all of the ASME organizations consider the types of information they could use to advantage when such processing is available and advise him.

President Warren emphasized that the obligation of the individual member cannot be too strongly stressed. Service on an ASME committee is an excellent means of professional development. Research Committee or Division service is the ideal way to keep abreast of developments in a particular area of technology. Division and Section people are the same persons although differently organized, and the man in the Section will soon be drawn into Division activities if he reads MECHANICAL ENGINEERING, other Society publications, and presents papers.

Conference Duplication

The final session, chaired by R. G. Folsom, was largely devoted to a discussion of the multiplicity of technical meetings.

Two aspects were developed. Everett M. Barber cited a metal-cutting bibliography compiled and abstracted by the John Crerar Library for a research committee which turned up between 10,000 and 11,000 references. A study by Battelle Memorial Institute indicated that all of these papers were generated from approximately 320 original papers. The meaning of this proliferation was sought in various comments. Some represented recombination which added some new material, but most would seem to be explained by interest-level differentiation—reports in trade journals or other publications which represented interpretation for different levels of technology and management.

This applies equally to the multiplicity of conferences. ASME Secretary O. B. Schier, II, emphasized that a horizontally organized Society such as ASME must provide adequate service for the specialist or be faced with the development of splinter groups or specialty organizations.

Attendance is the best indication of need and interest, according to L. N. Rowley. As long as attendance continues to increase, needs exist and are being met. When attendance drops, we must find out why.

Conference to Chart Trends in Textile Engineering

The Textile Engineering Division of The American Society of Mechanical Engineers will hold a conference to discuss trends, March 12–13, 1959, at Clemson College, Clemson, S. C. The conference is sponsored by the Textile Engineering Division with the cooperation of three of the Society's Sections; namely, Greenville, South Carolina, Piedmont-Carolina Section, and Eastern North Carolina Section.

▶THURSDAY, MARCH 12

Registration **8:00 a.m.–12:00 Noon**

Session 1 **9:30 a.m.**

Chairman: *T. W. Watson*, Chairman, ASME Greenville Section

Vice-Chairman: *L. C. Tolleson*

Welcome: *J. H. Sams*, dean, School of Engineering, and *Gaston Gage*, dean, School of Textiles, Clemson College

Modern Finishing-Plant Design, by *H. M. Rogers*, Lockwood-Greene Engineers, Inc., Spartanburg, S. C.

Trends in Finishing-Plant Ventilation, by *H. W. Frederick*, J. E. Sirrine Company, Greenville, S. C.

Discussion

Moderator: *J. C. Whitehurst*, James Hunter, Inc., Greenville, S. C.

Informal Luncheon **12:30 p.m.**

Session 2 **2:00 p.m.**

Chairman: *E. M. Ketchie*, Chairman, ASME Piedmont-Carolina Section

Vice-Chairman: *J. R. Powell*

Radiant Heat Drying, by *R. B. Chipman*, Gen. Elec. Co., Charlotte, S. C.

Air Dryers and Curing Ovens, by *B. R. Andrews, Jr.*, Andrews-Goodrich Division, J. O. Ross Engineering Corp., New York, N. Y.

Discussion

Moderator: *A. D. Asbury*, J. E. Sirrine Co., Greenville, S. C.

Social Hour **6:15 p.m.**

Banquet **7:00 p.m.**

Speaker: *F. P. Bennett*, president and executive editor, *America's Textile Reporter*, Boston, Mass.

▶FRIDAY, MARCH 13

Session 3 **9:00 a.m.**

Chairman: *K. T. Knight*, Chairman, ASME Eastern North Carolina Section

Vice-Chairman: *H. P. Richmond*

Magnetic Drafting System, by *R. M. Jones*, Saco-Lowell Shops, Biddeford, Me.

Modern Spinning—The Piedmont Frame, by *Carl Brandt*, Whitin Machine Works, Whitinsville, Mass.

The Unifil, by *Charles Land*, Universal Winding Co., Providence, R. I.

Shuttleless Loom, by *F. M. Fitzgerald*, Draper Corp., Hopedale, Mass.

Discussion

Moderator: *J. L. Chapman*, Ralph E. Loper Co., Greenville, S. C.

Campus Tours **2:00 p.m.**

Tours of the laboratories and facilities of the School of Engineering and the School of Textiles.

ASME Symposium on Stall in Fluid Flow Attracts Large Audience

A Symposium on Stall in Fluid Flow was held on Dec. 4 and 5, 1958, during the Annual Meeting of The American Society of Mechanical Engineers. Sponsored by the Fluid Mechanics Committee of the Hydraulic Division, this Symposium offered an excellent opportunity for the exchange of information among research fluid-dynamicists on one hand and practicing engineers on the other. The overwhelming response was evidenced by the participation of 27 scheduled speakers, each a recognized specialist in his field, a large number of discussers, and an enthusiastic audience of more than 300 engineers and scientists. The area covered in the four sessions of the Symposium ranged all the way from the latest theoretical considerations of laminar and turbulent boundary layers to the rational design of compressors and turbines. A brief rundown of the topics and their speakers follows.

Scope of the Meeting

The opening lecture "Application of Boundary Layer Theory in Turbomachinery" was delivered by Prof. H. Schlichting of Institüt für Strömungsmechanik, Braunschweig, Germany. In his lecture Professor Schlichting described the calculation of the aerodynamic coefficients of a two-dimensional cascade by viscous flow theory and the application of these calculations in predicting the performance of axial-flow compressors.

Following the opening lecture, was Part 1 of the Symposium; in this Part our present basic knowledge of boundary-layer flows in adverse pressure gradients was surveyed by various authorities. The two-dimensional turbulent boundary layer was surveyed by G. B. Schubauer of National Bureau of Standards, with additional contribution by C. T. Hewson of Rolls-Royce Ltd. The three-dimensional boundary layer and separation was discussed by A. G. Hansen of Cornell Aeronautical Laboratory and J. P. Johnston of Ingersoll-Rand Company, with additional contributions from E. A. Eichelbrenner of ONERA, Mandes, France, and R. A. Oman of Grumman Aircraft Engineering Corporation.

The unsteady boundary layer was the topic chosen by F. K. Moore of Cornell Aeronautical Laboratory. Separation and eddy shedding was surveyed by A. E. Bryson of Harvard University.

F. Kreith of Lehigh University presented some recent findings on unsteady flow induced by a disk rotating between parallel plates. The subject of transitory stall was surveyed by S. J. Kline of Stanford University; cavitation and separation by G. F. Wislicenus of Pennsylvania State University; shock and separation by S. M. Bogdonoff of Princeton University and M. V. Morkovin of Martin Company; separation at supersonic speeds by D. M. Kuehn of Ames Laboratory, NASA; loss of separated flows by W. G. Cornell of General Electric Company; control of separation by energizing or suction by K. F. Rupert of Langley Laboratory, NASA; control of separation by vortex generation by H. D. Taylor of United Aircraft Research.

Control of separation by stabilizing devices was covered by S. J. Kline of Stanford University with discussions by R. C. Dean of Ingersoll-Rand Company. This concluded Part 1 of the Symposium on Basic Surveys.

Part 2 of the Symposium covered actual applications where in a rational approach to stall prediction and control has yielded gains in performance. The topics and discussers in Part 2 included: Surge in centrifugal impellers by J. T. Hamrick of Thompson-Ramo-Wooldridge; backflow in centrifugal compressors by E. M. Knoernschild of AiResearch; supersonic

1959 ASME Lubrication Conference

The annual Spring Conference of the Lubrication Division of The American Society of Mechanical Engineers will be held March 16 and 17 at The Franklin Institute in Philadelphia, Pa. The general subject of the conference is "Wear of Lubricated Surfaces."

Three of the four sessions of this conference will be conducted as symposiums; the fourth session will be devoted to the presentation of formal papers. The symposiums deal with the following topics: Influence of lubricants and additives on wear reduction; wear control through design; and radioactive and other studies in wear research.

diffusers by N. Van Le of AiResearch; radial diffusers by R. Hunstad of Westinghouse Research Laboratory; design considerations and performance of a 1400 ft./sec. tip speed compressor rotor by J. K. Klapproth of General Electric Company; the effect of tip clearance on the peak pressure rise of axial-flow fans and compressors by L. H. Smith, Jr., of General Electric Company; development of the laminar-flow turbine blade profile by H. Kraft of General Electric Company; and the use of fundamental boundary-layer parameters in describing turbine loss characteristics by L. Stewart of Lewis Laboratory, NASA.

Does the Theory Apply?

While it would be impossible obviously to delve into details on any one of the talks listed above, an interesting note can be made on the degree of success or the lack of it in applying theory to actual problems. There exist certain problems that can be predicted by theory with fair amount of success, such as, for example, the two-dimensional cascade discussed by Professor Schlichting. On the other hand, the majority of problems in passage flow including stall prediction cannot yet be treated satisfactorily by analysis alone. In fact, in certain areas a successful design is still very much an "art" instead of a science. One objective of this Symposium was to co-ordinate attempts to narrow down such areas of "darkness" by finding new or improved rational methods. It is indeed interesting to speculate that, if another Symposium on Stall should be held five or ten years from now, how much progress will we be able to report toward the afore-mentioned objective?

Proceedings of Symposium Available

Almost all the speakers listed in the Symposium had submitted beforehand an outline of their talk together with all the figures to be used in the presentation. These outlines and figures have been collected and reproduced in a bound volume which was distributed before the meeting to all those who had expressed a wish to attend the Symposium. Copies of this collected material have been deposited with ASME headquarters, the Library of Congress, the Engineering Societies Library, the Library of the Institute of the Aeronautical Sciences, and University-Microfilms, Ann Arbor, Mich. Microfilm or opaque copies are available from the latter source.

ASME Oil and Gas Power Conference In Houston Again to Feature Industry-Wide Exhibit

The thirty-first annual Oil and Gas Power Conference and Exhibit will be held at The Shamrock-Hilton Hotel, April 19–23, sponsored by the Oil and Gas Power Division of The American Society of Mechanical Engineering with the co-operation of the South Texas Section.

The technical program will highlight the latest developments in this field. The custom of having manufacturers in the field display their products and reports on recent developments has resulted in a closer tie-in between the engineers and industry. The Oil and Gas Power Exhibit has become an integral part of this conference.

This year's conference also features a tour of Pipeline Compressor Stations and a boat trip up the Houston Ship Channel.

▶ MONDAY, APRIL 20

Session 1 **9:30 a.m.**

Development of a High-Compression Ratio Gas Engine,[1] by *R. D. Henderson* and *J. C. Hallinan*, Caterpillar Tractor Co., Peoria, Ill.

Development and Application of a Small Four-Cycle Turbocharged Gas Engine, *W. M. Kauffmann* and *D. E. Schults*, Worthington Corp., Buffalo, N. Y. (Paper No. 58—OGP-1)

Session 2 **2:30 p.m.**

Report: **AIEE-ASME Recommended Specifications for Speed Governing of Internal-Combustion Engine-Generator Units,**[1] by *L. J. Moulton*, Marquette Metal Products Div., Curtis-Wright Corp., Cleveland, Ohio

Report: **Standard Practices of the DEMA for Slow and Medium-Speed Gas and Oil Engines,**[1] **Fifth edition,** by *T. M. Robie*, Eibor Services, Inc., Beloit, Wis.

Report: **Development of ASME-OGP Division Power Cost Reports,**[1] by *C. P. Keller*, Department of Public Utilities, Rockville Center, L. I., N. Y.

What's New?—Three Minute Briefs of New Developments in the Industry,[1] by *Representatives of Exhibiting Manufacturers*

Special Lecture **8:00 p.m.**

Chairman: *Seymour Orlofsky*, vice-president, Columbia Gulf Pipeline Co., Houston, Texas

Subject: **Automation in the Oil and Gas Industry**

Lecturer: *W. S. Quimby*, senior technologist, Research and Technical Department, The Texas Co., Beacon, N. Y.

▶ TUESDAY, APRIL 21

Session 3 **9:30 a.m.**

Turbocharging Development—Two-Cycle Radial Engines for Point Comfort,[1] by *Robert Cramer, Jr.*, Nordberg Mfg. Co., Milwaukee, Wis., and *Howard Keefer*, Aluminum Co. of America, Point Comfort, Texas

Installation, Operation, and Maintenance of Turbocharged Two-Cycle Gas-Engine Compressors,[1] by *G. H. Bollman* and *W. H. Payne*, Clark Bros. Co., Olean, N. Y.

Nondestructive Inspection Procedures for Pipe-Line Equipment,[1] by *C. F. Dye*, El Paso Natural Gas Co., El Paso, Texas

ASME Papers by Mail

Only *numbered* ASME papers in this program are available in separate copy form until Feb. 1, 1960. Copies can be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Prices are 40 cents each to members of ASME; 80 cents each to nonmembers. Papers must be ordered by the paper numbers listed in this program, otherwise the order will be returned. The final listing of available technical papers will be found in the issue of Mechanical Engineering containing an account of the conference.

▶ WEDNESDAY, APRIL 22

Session 4 **9:30 a.m.**

Lubrication! Sez Who?[1] by *R. L. Churchwell* and *F. J. Kokas*, Tennessee Gas Transmission Co., Houston, Texas

Field Study of Gas-Engine Lubricants,[1] by *C. M. B. Floyd* and *E. D. Shannon*, Humble Oil and Refining Co., Houston, Texas

Session 5 **2:30 p.m.**

Panel Discussion: Engine Foundations—Design Theory and Construction

Moderator: *Robert Cramer, Jr.*, Nordberg Manufacturing Co., Milwaukee, Wis.

Chairman: *John C. Gibb*, senior engineering representatives, Socony Mobil Oil Co., Inc., New York, N. Y.

Panel Discussion: Engine Lubrication and Oil Filtering

Moderator: *F. L. Townsend*, sales manager, William W. Nugent & Co., Skokie, Ill.

Chairman: *John C. Gibb*, senior engineering representative, Socony Mobil Oil Co., Inc., New York, N. Y.

Panel Members:

F. V. Cook, master mechanic, Service Pipeline Co., Tulsa, Okla.

R. D. Milham, superintendent, Compressor Stations, American Louisiana Pipeline Co. Detroit, Mich.

George W. White, assistant chief engineer, Tennessee Gas Transmission Co., Houston, Texas

F. M. Steele, The Hilliard Corp., Elmira, N. Y.

▶ THURSDAY, APRIL 23

Session 6 **9:30 a.m.**

Evaluation of Corrosion in Diesel Cylinders,[1] by *J. M. A. van der Horst*, Van der Horst Corp. of America, Olean, N. Y., and *W. Schultse*, Lemet Chromium N. V., Kortenhoef, the Netherlands

Engine Waste-Heat Utilization in a High-Speed Geared Steam Turbine,[1] by *J. C. Georgian*, Washington Univ. and consultant, Engineering Controls, Inc., St. Louis, Mo.

Production Design of a Modern Axial-Flow Positive Displacement Rotary Compressor,[1] by *W. C. Fischer*, Fairbanks, Morse & Co., Beloit, Wis.

Session 7 **2:30 p.m.**

Advantages of a Tailor-Made Construction Contract,[1] by *R. J. Smail*, Dravo Corp., Pittsburgh, Pa.

---

[1] Paper not available—see box on this page.

ASME Metals Engineering Conference to Be Held in Albany, April 29–May 1

The Hudson-Mohawk Section of The American Society of Mechanical Engineers will be host for the 1959 Metals Engineering Division Conference to be held at the Sheraton-TenEyck Hotel, Albany, N. Y., from April 29 through May 1. The theme of the meeting is "Behavior of Metals in Engineering Structures."

The meeting will feature eight technical sessions, a dinner address by ASME President Glenn B. Warren on the challenges of the design engineer to the metals engineer, and a luncheon address by ASME Vice-President A. W. Weber on the development of nonmetallics with metal-type properties.

The opening session will present a review of the behavior of metals by J. Gilman of General Electric, and Prof. M. E. Shank of M.I.T. will discuss the topic from the "engineering" point of view. The closing session will consider the selection of materials, quality control, and design problems of heavy sections of metal as seen by both metal producers and equipment manufacturers.

Other sessions will be concerned with elevated temperature behavior, brittle fracture, fatigue, nonmetallics, and a status report from the ASME Research Committee on the Prevention of Fracture in Metals. A strong effort is being made to insure that the latest advances in metals engineering are discussed.

Any inquiries should be addressed to Mr. W. L. Fleischmann, Knolls Atomic Power Laboratory, P. O. Box 1072, Schenectady, N. Y.

▶TUESDAY, APRIL 28

Registration 5:00–7:00 p.m.

▶WEDNESDAY, APRIL 29

Registration 9:00–10:00 a.m.

Session 1 10:00 a.m.

Chairman: *John J. B. Rutherford, Jr.*, Tubular Products Division, The Babcock & Wilcox Co., Beaver Falls, Pa.

Vice-Chairman: *John E. Corr*, supervisor—turbine bucket and rotor engineering, large steam-turbine-generator department, General Electric Co., Schenectady, N. Y.

The Nature of Plastic Flow and Fracture, by *J. J. Gilman*, General Electric Co., Schenectady, N. Y.

Some Engineering Aspects of Flow and Fracture, by *M. E. Shank*, M.I.T.

Session 2—Brittle Fracture 2:00 p.m.

Chairman: *L. W. Smith*, nuclear components department, Combustion Engineering, Inc., Chattanooga, Tenn.

Vice-Chairman: *E. F. Nippes*, Rensselaer Polytechnic Institute, Troy, N. Y.

Relations Between the Notch-Tensile Strength of Cylindrical and Prismatic Specimens of Titanium Alloys and Heat-Treated Steels, by *G. Sachs*, *J. G. Sessler*, *R. F. Pray*, and *T. H. Yeh*, Syracuse Univ. Res. Inst.

Nonmetallic Inclusions and Fracture Behavior of Steel, by *S. Yukawa*, Gen. Elec. Co., Schenectady, N. Y.

A Unified Interpretation of Room-Temperature Strength of Sharply Notched Geometrically Similar Tensiles and Bend Bars as Influenced by Their Size, by *B. M. Wundt*, Gen. Elec. Co., Schenectady, N. Y.

Effect of Plate Thickness on Fracture Strength, by *G. R. Irwin*, Mechanics Division, Naval Res. Lab., Washington, D. C.

Reception 6:00–7:00 p.m.

Dinner 7:30 p.m.

Toastmaster: *Richard G. Folsom*, Director, ASME, president, Rensselaer Polytechnic Institute

Address: *Glenn B. Warren*, ASME President, vice-president and consulting engineer, Turbine Division, General Electric Co., Schenectady, N. Y.

Subject: **The Challenges of the Mechanical Engineer to the Metallurgical Engineer**

▶THURSDAY, APRIL 30

Session 3 9:00 a.m.

Panel: Fracture Prevention

Chairman: *Mortimer F. Sayre*, professor-emeritus, Union College

Vice-Chairman: *Dolph G. Ebeling*, manager, metallurgy operation, Materials and Processes Laboratory, large steam-turbine-generator department, General Electric Co., Schenectady, N. Y.

Subcommittee Reports

Chairman of Subcommittee on Notch Sensitivity: *John D. Lubahn*, Knolls Atomic Power Lab. Gen. Elec. Co., Schenectady, N. Y.

Chairman of Subcommittee on High-Temperature Combined Stress: *M. J. Manjoine*, mechanics department, Westinghouse Res. Labs., East Pittsburgh, Pa.

Chairman of Subcommittee on Low-Cycle Fatigue: *K. R. Merckx*, Hanford Labs. Operation, Gen. Elec. Co., Richland, Wash.

Luncheon 12:30 p.m.

Toastmaster: *James F. Young*, manager, general engineering lab, General Electric Co., Schenectady, N. Y.

Address: *Arthur W. Weber*, ASME Vice-President, Region III vice-president, Corning Glass Works, Corning, N. Y.

Subject: **Nonmetallic Structural Materials**

Session 4—Nonmetallic Structural Materials 2:30 p.m.

Chairman: *George M. Sinclair*, department of theoretical and applied mechanics, Univ. of Illinois

Vice-Chairman: *Donald F. Wilcox*, manager, materials engineering, General Electric Co., Schenectady, N. Y.

Ceramics Made from Glass, by *S. D. Stooky*, Corning Glass Works, Corning, N. Y.

Ceramics for Advanced Engineering Applications, by *L. R. McCreight*, Gen. Elec. Co., Philadelphia, Pa.

Steel-Bonded Heat-Treatable Carbides, by *J. L. Ellis*, Sinter Cast Corp., Yonkers, N. Y.

Session 5—Creep Behavior of Metals 7:30 p.m.

Chairman: *Paul M. Brister*, The Babcock & Wilcox Co., N. Y.

Vice-Chairman: *W. W. Dyrkacz*, Allegheny-Ludlum Steel Corp., Watervliet, N. Y.

Design of Pressurized Cylinders Subject to Creep, by *J. F. Traexler*, Westinghouse Elec. Corp., Lester, Pa.

Steady Creep of a Tube Under Combined Bending and Internal Pressure, by *Iain Finnie*, Shell Oil Co., Houston, Texas

Creep-Rupture Tests for Design of High-Pressure Steam Equipment, by *E. A. Davis*, Westinghouse Res. Labs., East Pittsburgh, Pa.

The Influence of Pipe-Wall Thickness on Creep Behavior, by *E. Coulter*, *J. Tucker*, and *L. F. Kooistra*, The Babcock & Wilcox Co., New York, N. Y.

▶FRIDAY, MAY 1

Session 6—Fatigue 9:00 a.m.

Chairman: *Herbert T. Corten*, theoretical and applied mechanics department, Univ. of Illinois.

Vice-Chairman: *Robert Plunkett*, consulting engineer, general engineering laboratory, General Electric Co., Schenectady, N. Y.

A Generalization of Cumulative Damage, by *R.M. Mains*, consulting engineer, Knolls Atomic Power Lab., Gen. Elec. Co., Schenectady, N. Y.

The Effect of Relaxation on the Behavior of Metals Under Combined Alternating and Static Stress, by *F. H. Vitovec*, Univ. of Wisconsin

Thermal Strain Cycling Tests on DCM, A Nickel Base Alloy, by *F. J. Mehringer* and *R. P. Felgar*, general engineering laboratory, Gen. Elec. Co., Schenectady, N. Y.

Cyclic Operation of Pressure Piping With Gamma Heating, *K. R. Merckx*, Hanford Labs. Operation, Gen. Elec. Co., Richland, Wash.

Session 7—High-Temperature Behavior 9:00 a.m.

Chairman: *M. J. Manjoine*, research engineer, Westinghouse Res. Labs., East Pittsburgh, Pa.

Vice-Chairman: *Robert M. Parke*, research laboratory, Gen. Elec. Co., Schenectady, N. Y.

Report of Project SP-4 of the Steam Power Panel of the ASME-ASTM Joint Committee on the Effect of Temperature and the Properties of Metals, by *J. S. Worth*, Bethlehem Steel Corp., Bethlehem, Pa.

Application of the Moire—Effect to the Measurement of Plastic Strains, by *A. Vinckier*, Westinghouse Res. Labs., East Pittsburgh, Pa.

Notch-Rupture Strength of Type-347 Heat-Affected Zone, by *R. J. Christoffel*, Gen. Elec. Co., Schenectady, N. Y.

Report of Anomalous Brittle Failures of Heavy Steel Forgings at Elevated Temperatures, by *A. J. Babecki*, *P. P. Pusak*, and *W. S. Pellini*, U. S. Naval Res. Lab., Washington, D. C.

Session 8—Workshop on the Application of Metals in Heavy Sections 2:30 p.m.

Chairman: *Robert M. Curran*, large steam turbine-generator department, Gen. Elec. Co., Schenectady, N. Y.

Vice-Chairman: *Robert W. Bennett*, chief metallurgical engineer, Alco Products Corp., Schenectady, N. Y.

Design, *A. W. Rankin*, manager, turbine structural engineering, large steam turbine-generator department, Gen. Elec. Co., Schenectady, N. Y.

Materials Selection, *T. G. Foulkes*, metallurgical engineer, Bethlehem Steel Corp., Bethlehem, Pa.

Quality Control, *R. E. Lorens*, Combustion Engineering, Inc., Chattanooga, Tenn.

Specifications From the Metal-Producers' Viewpoint, *George T. Jones*, U. S. Steel Corp., Pittsburgh, Pa.

Specifications From the Equipment Producers' Viewpoint, *Norman L. Mochel*, Westinghouse Elec. Corp., Lester, Pa.

ASME Pittsburgh Bicentennial Conference

Pittsburgh Section of ASME is sponsoring a two-day meeting on "Pollution and the Solution—Its Contribution to Pittsburgh's Renaissance"; April 20–21 Penn-Sheraton Hotel Pittsburgh.

Dr. Lawrence Faith, managing director, Air Pollution Foundation, will be a featured speaker.

For further information, write N. H. Eckler, Gulf Research and Development Company, Box 2038, Pittsburgh 30, Pa.

In photo of Ford River Rouge plant, *foreground,* one sees Rotunda, the plant, turning basin for ships; *upper center,* between gas tanks, six tall smokestacks locate the famous River Rouge Powerhouse. The Detroit River and Canada can be seen in *background.* All these and more to be seen during ASME Production Engineering Conference, May 12–14.

1959 ASME Production Engineering Conference to Be Held in Detroit, Mich., May 12–14

The Production Engineering Division of The American Society of Mechanical Engineers will hold their Annual Conference this year in Detroit, Mich., on May 12 through 14 at the Statler Hilton Hotel. The tentative program includes ten technical sessions sponsored by a number of Professional Divisions of the Society. The main theme for this year's meeting will be "Engineering For Productivity" and will be subdivided into those main groups, namely; product, organization, and processes. A joint technical session will be featured on Tuesday, May 12, with all three fields joining in a common meeting. On Wednesday and Thursday, May 13 and 14, respectively, each group will hold concurrent technical sessions. In addition to the technical sessions, a number of field trips are being planned. These will include visits to each of the "big three" automobile manufacturers plants in Detroit and suburbs: Ford, General Motors, and Chrysler. The Ford Motor Company tour will be through the huge, industrial, Rouge Plant in Dearborn, Mich. The General Motors tour will be through the Technical Center in suburban Warren, Mich. The Chrysler tour will be through their modern engine plant on Mound Road in Detroit.

Among the many interesting technical papers to be presented at this conference will be the following: "Untapped Sources of Productivity," by T. E. Shea, Vice-President—Engineering Division, Western Electric Company, Inc., New York, N. Y.; "Measurement of Productivity," by Prof. J. W. Kendrick, Washington University, Washington, D. C.; and "Computers as a Tool in Product Engineering," by Dr. C. R. Decarlo, Director of Marketing, IBM, New York, N. Y.

Detroit, Mich., is world famous as a production center for many products, chiefly automobiles. This has provided magnetic attraction for numerous allied industries including automatic machine tools of all types. These have as their prime purpose the increasing of productivity. The big three automotive manufacturers, of course, Ford, General Motors, and Chrysler, provide the main attraction in the area. All three have great industrial empires centered in or near Detroit which will be available to the Production Engineering Division. This certainly provides a once-in-a-lifetime opportunity for the study of production engineering in regard to the product, the organization, and the process.

In addition to the technical side, the Conference Meeting will take on an international flavor, due to the close proximity of Windsor, Ont., Canada. Located directly across the Detroit River and easily accessible from Detroit, this quaint Canadian city is a mecca for tourists and features fine English china and woolens in convenient shops.

The Women's Auxiliary of the Detroit Section will again be active during this conference. A program is being planned which will be interesting and informative.

1959 RAC Meetings Schedule

Date	*Day*	*Location*	*Hotel*	*Region*	*Section*
April 6-7	Mon-Tues	New Orleans, La.	Jung	VIII	New Orleans
April 16-17	Thurs-Fri	Washington, D.C.	Hedin House*	III	Washington, D.C.
April 18-19	Sat-Sun	Gainesville, Fla.	Thomas	IV	Florida
April 20-21	Mon-Tues	Toronto, Canada	Park Plaza	V	Ontario
April 24-25	Fri-Sat	South Bend, Ind.	Oliver	VI	St. Joseph Val.
April 11-12	Sat-Sun	Sun Valley, Idaho	Sun Valley Lodge	VII	Inland Empire
May 1-2	Fri-Sat	Boston, Mass.	Statler**	I	Boston
May 4-5	Mon-Tues	Poughkeepsie, N.Y.	Nelson House	II	Mid-Hudson

Palm Sunday	Mar. 22
Good Friday	Mar. 27
Easter Sunday	Mar. 29

* Meeting at Catholic University
** Meeting at M.I.T. Faculty Club

ASME COMING EVENTS

March 8–11

ASME Gas Turbine Power Conference and Exhibit, Netherlands-Hilton Hotel, Cincinnati, Ohio

March 9–12

ASME Aviation Conference, Statler-Hilton Hotel, Los Angeles, Calif.

March 12–13

ASME Textile Engineering Conference, Clemson College, Clemson, S.C.

March 16–17

ASME Lubrication Conference, The Franklin Institute, Philadelphia, Pa.

March 29–April 1

ASME Instruments and Regulators Conference, Case Institute of Technology, Cleveland, Ohio

March 31–April 2

American Power Conference, Hotel Sherman, Chicago, Ill.

April 5–10

Nuclear Congress, Cleveland Auditorium, Cleveland, Ohio

April 8–9

ASME-AIEE Railroad Conference, Sheraton Hotel, Chicago, Ill.

April 13–15

ASME Hydraulics Conference, University of Michigan, Ann Arbor, Mich.

April 19–23

ASME Oil and Gas Power Conference, Shamrock-Hilton Hotel, Houston, Texas

April 23–24

ASME Management-SAM Conference, Statler Hilton Hotel, New York, N.Y.

April 29–May 3

ASME Metals Engineering Conference, Sheraton-Ten Eyck Hotel, Albany, N.Y.

May 4–5

ASME Maintenance and Plant Engineering Conference, Edgewater Beach Hotel, Chicago, Ill.

May 12–14

ASME Production Engineering Conference, Statler-Hilton Hotel, Detroit, Mich.

May 25–28

ASME Design Engineering Conference, Convention Hall, Philadelphia, Pa.

June 1–3

ASME Boiler and Pressure Vessel Committee Out-of-Town Meeting, Palliser Hotel,Calgary, Alberta, Canada

June 14–18

ASME Semi-Annual Meeting, Chase-Park Plaza Hotel, St. Louis, Mo.

June 18–20

ASME Applied Mechanics Conference, Virginia Polytechnic Institute, Blacksburg, Va.

August 9–12

ASME-AIChE Heat Transfer Conference, University of Connecticut, Storrs, Conn.

September 10–12

ASME Wood Industries Conference, Multnomah Hotel, Portland, Ore.

September 17–18

ASME-AIEE Engineering Management Conference, Statler-Hilton Hotel, Los Angeesl, Calif.

September 20–23

ASME Petroleum Mechanical Engineering Conference, Rice Hotel, Houston, Texas

September 27–October 1

ASME-AIEE National Power Conference, Hotel Muehlebach, Kansas City, Mo.

October 20–22

ASME-ASLE Lubrication Conference, Hotel Sheraton-McAlpin, New York, N.Y.

November 4–6

ASME-IRE-AIEE-ISA National Automatic Control Conference, Sheraton Hotel, Dallas, Texas

November 29–December 4

ASME Annual Meeting, Chalfonte-Haddon Hall, Atlantic City, N.J.

(*For Meetings of Other Societies, see page 117*)

Note: Members wishing to prepare a paper for presentation at ASME national meetings or divisional conferences should secure a copy of Manual MS-4, "An ASME Paper," by writing to the ASME Order Department, 29 West 39th Street, New York 18, N.Y., for which there is no charge providing you state that you are a member of ASME.

1959 Society Records Sent Upon Request

Members of The American Society of Mechanical Engineers who wish to receive a copy of February, 1959, issue of Society Records containing the personnel of the Council, Boards, and Committees (AC-10) may do so by requesting the pamphlet from the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

Snorkel Innovator to Speak at the Design Engineering Conference

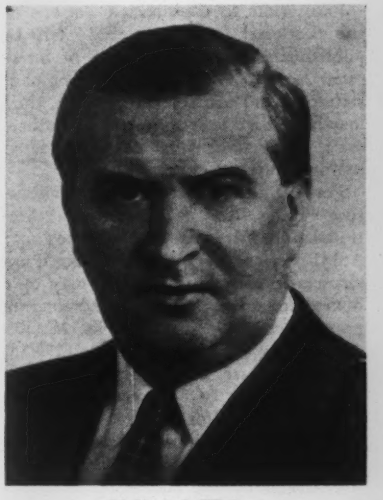
Hellmuth Walter who won world-wide fame through his introduction of the "Snorkel" as a standard item of equipment on German submarines, will be the major speaker at the first day's panel session of the Design Engineering Conference, May 25–28, Philadelphia, Pa.

The Machine Design Division of The American Society of Mechanical Engineers with the co-operation of the Philadelphia Section will sponsor technical sessions in the fields of materials, power and controls, mechanical components, and general engineering.

Held concurrently with the Conference will be the Design Engineering Show which is produced by Clapp & Poliak, Inc., New York exposition management firm. Conference sessions will take place in the mornings and the Show will be open during the afternoons.

Through his firm, H. Walter K. G., Mr. Walter provided the hydrogen-peroxide gas turbines and propulsion equipment for German submarines. He also manufactured hydrogen-peroxide propulsion systems for trackless torpedoes, auxiliary equipment for heavy aircraft take-off, and turbines for missiles and the first rocket-powered fighter-interceptor plane.

Starting work with the Worthington Corporation in 1950, his efforts have been directed along three major lines: that of finding more effective means for recovering oil after primary and secondary efforts have been exhausted; improving and simplifying presently known methods of compressing air and gas; and developing gas turbines. Since June of 1955 Mr.



Hellmuth Walter

Walter has been director of research encompassing all of Worthington's far-flung activities.

A session on the last day will discuss the efficient organization of a design department from the viewpoint of the company and its activities, and the efficient use of engineers and their talents within a company.

On the second and third days of the Conference, there will be three concurrent sessions dealing with choice of materials in design, mechanical aspects of design, and power and control.

Materials sessions will cover the latest developments in plastics, materials, and metals for service over 1000 F, and materials and coatings to resist corrosion. Mechanical sessions will deal with methods of power transmission and the theory and selection of bearings. For the power and control sessions, papers on drive systems and conversion devices, and digital systems and logic circuits for controls, will be presented.

Information about the Conference may be obtained by writing to ASME, 29 West 39th Street, New York 18, N. Y. Show information is available from Clapp & Poliak, Inc., 341 Madison Avenue, New York 17, N. Y.

1959 Regional Student Conferences

Region		**Host**	**City and State**	**Date**
I	New England	Worcester Polytechnic Institute	Worcester, Mass.	April 17-18
II	Eastern	Stevens Institute of Technology	Hoboken, N.J.	April 11
III	Alleghenies	Lafayette College	Easton, Pa.	April 17-18
IV	Southern	University of Florida	Gainesville, Fla.	April 17-18
V	Midwest	University of Michigan	Ann Arbor, Mich.	April 17-18
VI	Northern Tier	South Dakota State College	Brookings, S. Dak.	May 1-2
VI	Southern Tier	Purdue University	West Lafayette, Ind.	April 3-4
VII	Pacific Northwest	Oregon State College	Corvallis, Ore.	April 30-May 1
VII	Pacific Southwest	University of Southern California	Los Angeles, Calif.	April 24-25
VIII	Northern Tier	University of Arkansas	Fayetteville, Ark.	April 27-28
VIII	Southern Tier	Louisiana State University	Baton Rouge, La.	April 17-18
VIII	Rocky Mountain Tier	University of Wyoming	Laramie, Wyo.	April 10-11

ASME CODES AND STANDARDS WORKSHOP

Interpretations of 1955 Code for Pressure Piping

From time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinions of the Committee.

Pending revision of the Code for Pressure Piping, ASA B31.1-1955, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions. Cases No. 26 (Reopened), 34 (Reopened), 35, 36, 37, 38, 39, and 40 are published herewith as interim actions of Sectional Committee B31 on the Code for Pressure Piping that will not constitute a part of the Code until formal action has been taken by the ASME and by the American Standards Association on a revision of the Code.

Case No. 26 (Reopened)

Modify Inquiry to read: "... for piping of aqueous-type reactors in nuclear energy installations . . ."

Revise Reply as follows:

(1) *Add the sentence:*

The minimum carbon content of type 304 material and the maximum carbon content of type 304L material shall be 0.035 per cent by check analysis.

(2) *Replace present wording with the following:*

If welding is employed, all completed welds shall be inspected as follows:

(a) All longitudinal welds shall be fully radiographed.

(b) All circumferential welds shall be fully radiographed wherever possible.

(c) Where the size or configuration of the weld does not permit radiographing, it shall be examined by the fluid-penetrant method.

(d) Provisions (a) through (c) do not apply for services at or near the ordinary range of atmospheric temperatures, where these materials are employed primarily for their corrosion resistance, provided the piping is hydrostatic tested at $1^{1}/_{2}$ times the maximum allowable working pressure for the piping used.

Case No. 34 (Reopened)

Revise Reply to read:

Reply: It is the opinion of the Committee that austenitic steel pipe conforming to ASTM Specification A-376, types 304, 316 and 348, and to ASTM Specification No. A-358, types 304, 316, 321, 347 and 348, may be used for conventional service under Section 1 of the Code for Pressure Piping with the accompanying allowable stress values. [Stress values remain as before (November *M.E.*).]

Case No. 35

Inquiry: Table 2A of the Code for Pressure Piping (ASA B31.1-1955), Section 1, lists pipe to ASTM specification

A-155 but does not specify flange or firebox quality. What was intended?

Reply: It is the opinion of the Committee that firebox quality is intended, and that the accompanying allowable stress values and footnote should replace the values listed in the 1955 edition.

Case No. 36

Inquiry: In Par. 123 of ASA B31.1-1955 relative to short-time variations of pressure and temperature, how should these variations be treated?

Reply: It is the opinion of the Committee that Paragraph 123 should read as follows:

123 *Variations in Pressure and Temperature.*

(a) Piping systems shall be considered safe for operation if the maximum sustained pressure and temperature on any part do not exceed the design pressure and temperature under this Code for all component parts of the system. It is recognized that variations in pressure and temperature inevitably occur and, therefore, the piping system shall be considered safe for occasional operation for short periods at higher than the design pressure and temperature.

(b) Either pressure or temperature, or both, may exceed the design values if the stress in the pipe wall calculated by Formula 1, Par. 122, using the maximum expected pressure during the variation does not exceed the *S*-value allowable for the maximum expected temperature during the variation by more than the following allowances for the periods of duration indicated:

(1) Up to 15 per cent increase above the *S*-value during 10 per cent of the operating period;

(2) Up to 20 per cent of the *S*-value during one per cent of the operating period.

Case No. 37

Inquiry: The June 1958 MECHANICAL ENGINEERING on page 119 contains a proposed revision of Par. P-23(a) and (b) of Section I of the ASME Boiler and Pressure Vessel Code relative to *C* factor. Is similar action contemplated for Par. 122, Section 1 of ASA B31.1-1955?

Reply: It is the opinion of the Committee that Par. 122, Section 1, of ASA B31.1-1955 should be changed as follows:

Par. 122(a), change the definition of C to read:

C = allowance for threading and minimum structural stability, in inches.

Par. 122(b), revise to read:

(b) The values of *C* listed below do not include any allowance for corrosion and/or erosion, and additional thickness should be provided where they are expected. The allowance for threading and minimum structural stability are not intended to provide for extreme conditions of misapplied external loads or for mechanical abuse.

The value of *C* in Formula 1 shall not be less than that given for the respective material in the following list:

TYPE OF PIPE	VALUE[5] OF *C* IN INCHES
Cast Iron Pipe, centrifugally cast	0.14
Cast Iron Pipe, pit cast	0.18
Threaded steel, wrought iron or nonferrous	
$^3/_4$" and smaller	0.065
1" and larger	Depth of Thread
Grooved steel, wrought iron or nonferrous	Depth of Groove plus $^1/_{64}$
Plain end[6] steel or wrought iron, up to and including $3^1/_2$"	0.065
Plain end[6] steel or wrought iron 4" and larger	0.000
Plain end[6] nonferrous	0.000

Case No. 38

Inquiry: May piping components made of Nodular Cast Iron and to the dimensions of ASA Standards B.16.1, B.16b and B.16.5 be used in construction under the jurisdiction of Sections 1, 2 and 3 of the Code for Pressure Piping (ASA B31.1-1955)?

Reply: It is the opinion of the Committee that, pending the completion of studies now in progress in Sectional Committee B16 and B31, Nodular Cast Iron components made of material conforming to ASTM Specification A395-56T may be used under the Sections indicated in the Inquiry under the following conditions:

(a) Components whose dimensions conform to ASA B16.1 and B16b may be used at the following maximum pressure-temperature ratings at temperatures between minus 20 F and 650 F.

DIMENSIONS USED	MAXIMUM RATING
Class 125 C.I. (B16.1)	80 % of 150 lb Carbon Steel (B16.5)
Class 250 C.I. (B16b)	80 % of 300 lb Carbon Steel (B16.5)
150 to 600 lb Steel, inclusive	80 % of Carbon Steel rating

These ratings are applicable to valves providing that the valves in other respects merit these ratings. It is recognized that components made to the Class 125 and Class 250 standards or to API Std 600 may be heavier than those made to the 150-lb and 300-lb standards, respectively. In the case of these heavier components the additional wall thickness may be considered as additional correction allowance.

(b) Until further experience is developed, the pressure at operating temperature shall not exceed 1000 psi.

(c) Welding of the components is not employed in fabricating them in an assembled system.

TABLE FOR CASE NO. 35

Material	ASTM Spec	Grade	Tensile Strength Min	Values of *S* psi for temperatures in deg F not to exceed −20 to 650	700	750	800	850	900	950	1000	1050	1100
Electric Fusion Welded:													
Carbon Steel	A155[3]	C45	45000	10100	9800	8750	7500	5950					
		C50	50000	11250	10900	9900	8450	6550					
		C55	55000	12400	11900	10850	9200	7000					
Killed Carbon Steel		KC55	55000	12400	11900	10850	9200	7000					
		KC60	60000	13500	12900	11650	9700	7000					
		KC65	65000	14600	13950	12450	10250	7000					
		KC70	70000	15750	14950	13300	10800	7000					
Carbon Molybdenum Steel		CM65	65000	14600	14600	14600	14100	12950	11250				
		CM70	70000	15750	15750	15750	15200	13500	11500				
		CM75	75000	16900	16900	16900	16200	14300	11700				
1/2 Cr, 1/2% Mo Steel		1/2 CR	65000	14600	14600	14600	14100	12950	11250	9000	5600		
1% Cr, 1/2% Mo Steel		1 CR	60000	13500	13500	13500	13300	12800	11800	9900	6750	4500	2500
1 1/4 Cr, 1/2 Mo Steel		1 1/4 CR	60000	13500	13500	13500	13500	12950	11800	9900	7000	4950	3600
2 1/4% Cr, 1% Mo Steel		2 1/4 CR	60000	13500	13500	13500	13500	12950	11800	9900	7000	5200	3800

Note 3—The values tabulated apply to firebox quality material and to Class 2 pipe. For Class 1 pipe, which is heat treated and radiographed, these stresses may be increased by the ratio of 0.95 divided by 0.90.

(d) They shall not be used in lethal service, as defined in each of the Sections indicated in the Inquiry.

Case No. 39

Inquiry: May type 304 stainless steel be used in nuclear energy installations handling liquid sodium and sodium-potassium mixtures under the rules of Section 1 of the Code for Pressure Piping (ASA B31.1-1955)?

Reply: It is the opinion of the committee that type 304 stainless steel may be used in nuclear energy installations handling liquid sodium and sodium-potassium mixtures for construction under Section 1, provided the following conditions are observed:

(1) The materials shall at least conform to one of the following specifications:

Pipe	ASTM-A-376 ASTM-A-358-56T
Welding Fittings	ASTM-A-403
Forgings	ASTM-A-182

The minimum carbon content of all material shall be 0.035 per cent by check analysis.

(2) If welding is employed, all completed welds shall be inspected as follows:

(a) All longitudinal welds shall be fully radiographed.

(b) All circumferential welds shall be fully radiographed wherever possible.

(c) Where the size or configuration of the weld does not permit radiographing, it shall be examined by the fluid penetrant method.

(3) The allowable stress values for seamless materials shall be as follows:

TEMPERATURE, *F*	S VALUE
−20 to 100	18,750
200	16,650
300	15,000
400	13,650
500	12,500
600	11,600
650	11,200
700	10,800
750	10,400
800	10,000
850	9,700
900	9,400
950	9,100
1,000	8,800
1,050	8,500
1,100	7,500
1,150	5,750
1,200	4,500
1,250	3,250
1,300	2,450
1,350	1,800
1,400	1,400
1,450	1,000
1,500	750

(4) A joint factor of 0.95 shall be applied to longitudinal welds which have been fully radiographed.

Case No. 40

Inquiry: Section 1 of the Code for Pressure Piping (ASA B31.1-1955) does not mention reinforced concrete pipe. May such piping be used under Section 1?

Reply: It is the opinion of the Committee that, although the Code does not contain rules for the design of reinforced concrete pipe, pipe complying with the following specifications may be used for service water and condensing water systems at 43 psi and below at the ratings assigned in the specifications:

AWWA C-300—Reinforced Concrete Water Pipe—Steel Cylinder Type—Not Prestressed

AWWA C-301—Reinforced Concrete Water Pipe—Steel Cylinder Type—Prestressed

AWWA C-302—Reinforced Concrete Water Pipe—Noncylinder Type—Not Prestressed

Federal Spec. SS-P-381 Pipe—Pressure, Reinforced Concrete, Pretensioned Reinforcement (Steel Cylinder Type).

AN AMERICAN STANDARD to govern the size and design of shipping containers comes closer to reality as subcommittees of National Standards Committee MH-5, sponsored by The American Society of Mechanical Engineers, meet in New York. Of major interest to railroads, shipping lines, airlines and truckers, the standard will, when published, help to assure interchangeability and practical design of three major types of containers (pallet size—small enough to be handled by an ordinary lift truck; cargo size—intermediate; and van size—which might be used as a demountable truck body). Shippers, interested in economies of unit-load handling, are aiming at containers that could be interchanged among all forms of transportation without repacking. The Executive Committee of the standards project, which operates under the procedures of the American Standards Association, met on January 21 at ASME headquarters in New York, following meetings of its subcommittees on January 20. Thirty-five committee members represent such groups as materials-handling specialists, manufacturers, warehousers, transportation lines, the armed forces, and other government agencies. Models of suggested cargo-size units are inspected by Herbert H. Hall, *right*, chairman of the MH-5 Committee and Chester J. Heinrich. Mr. Heinrich, who brought the Navy-prepared models to the attention of the subcommittee of which he is chairman, is technical director, U. S. Navy Supply Research and Development Facility, U. S. Navy Supply, Bayonne, N. J. Messr. Hall and Heinrich are both members of ASME.

Conducted
for the
National Junior
Committee

A. S. GOLDSTEIN

JUNIOR FORUM

What Are Engineering Students Asking About the Profession?

By R. H. Engel[2] and L. P. Siegel[3]

The growth and recognition of the importance of the engineering profession, and the constantly increasing demand for well-trained young engineers, have created an awareness that the student entering engineering must be trained in more than just technical aspects. He wants to, and should know, what it is like to be a practicing engineer—what does the engineer do? What are the working conditions and what is required to fulfill the function of the various phases of engineering such as research, development, design, production, service, sales, teaching, and so on?

In order to attract large numbers of students with the best aptitude for engineering, the profession must provide the answers to these and many other well-founded questions. In this way, these young people will know what is expected of them and thus enter the profession better prepared to perform their functions properly.

The Associate Committee of the ASME Chicago Section, in March, 1958, inaugurated a new series of student forums on the subject of "What the Engineer Does." Forums were held at three major Chicago-area engineering schools: Northwestern University, Illinois Institute of Technology, and the University of Illinois at Navy Pier. These student forums were held under the auspices of the Chicago Section Educational Services Committee.

The attendance study indicated the presence of two basic types of students:

Type 1 Senior students, who were primarily interested in obtaining information they could use in deciding on jobs being offered during current industrial recruitment interviews.

Type 2 Underclassmen, whose prime concern was the field of engineering for which they should study and plan.

The attendance figures were as follows: Illinois Institute of Technology, 89 students; University of Illinois (Navy Pier Branch), 95 students; and Northwestern University, 93 students.

The general format of these forums lasted approximately two hours each. The first hour consisted of a formal presentation of facts. Then, a recess which was followed by an informal question and answer period.

An officer of the Chicago Section of ASME was present at each of these forums and presented a brief talk on "Opportunities in ASME." Furthermore, the discussions between the ASME speakers and the students were implemented by the presence of faculty advisers.

The panel of speakers, each a member of ASME, spoke about the specific field of mechanical engineering in which he is specializing. Each speaker is engaged in a different division of the mechanical-engineering profession.

Considerable interest and enthusiasm were indicated by the numerous responsive questions and the careful attention given to the speakers' comments. The forum was obviously thought-provoking and considered to be informative. The students appeared keenly interested in the information given by the younger engineers who apparently could speak on a level closer to the students' point of view. Perhaps the students believe they have more in common with the young engineer, or at least more than with the older engineers who may have moved into management and have interests too remote from the beginner.

Some pertinent observations on the meetings were made. These are: (*a*) Strict adherence to a time schedule was indicative of adequate preparation. (*b*) The dinner meeting prior to the forum, for purpose of previewing the program and exchange of ideas, was well received. (*c*) Uniformity of the presentation and adhering to a basic outline were considered desirable.

This was the most extensive student-forum program ever attempted by the Chicago Section of the ASME and it accomplished its specific objectives; namely, to give the engineering student an opportunity to hear directly from young engineers engaged in the various aspects of engineering such as research, development, design, production, service, sales, teaching, and the like. This information came to them in a manner that they could understand readily. Each member of the panel spoke on the specific duties and activities within his own field of specialization. This was

Chairman's Corner

An invitation is extended to all Associate Members of the Society to attend one or all of the National Junior Committee meetings in 1959. Should you find it possible to attend any or all of the meetings, please inform either the Chairman of the NJC or W. E. Reaser, Assistant Secretary, ASME, of your intention so that you may be notified in the event of a change in the meeting date.

The National Junior Committee is looking to you, the active young Associate Member, to support our programs and to formulate new ones.

Meeting Dates	Time	Location
March 7, 1959	10:00 a.m.	ASME Headquarters, New York, N. Y.
June 16, 1959	10:00 a.m.	ASME Semi-Annual Meeting, St. Louis, Mo.
Oct. 10, 1959	10:00 a.m.	ASME Headquarters, New York City
Dec. 1, 1959	2:00 p.m.	ASME Annual Meeting, Atlantic City, N. J.

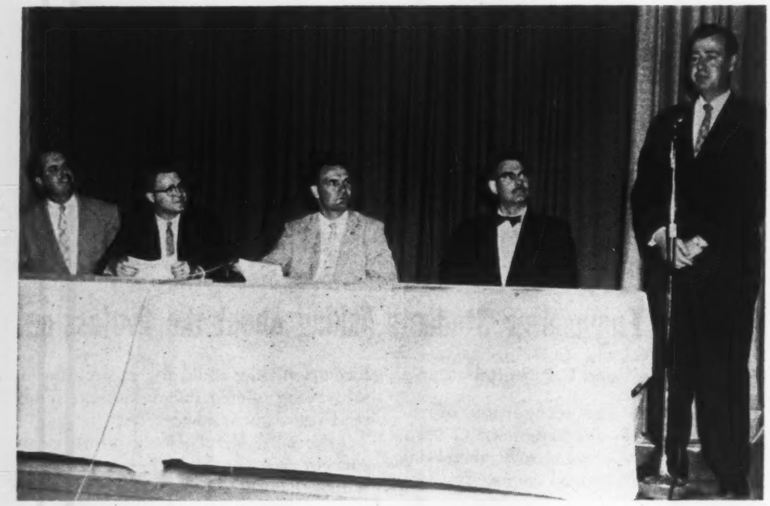
William M. Morley, *Chairman*, NJC
Elliott Company,
226 South 16th Street,
Philadelphia 2, Pa.

---

[1] Engineering writer, G. E. Advanced Electronics Center at Cornell University, Ithaca, N. Y. Assoc. Mem. ASME.

[2] Steam-service supervisor, Westinghouse Electric Corporation, Chicago, Ill. Assoc. Mem. ASME; Student Forum Subcommittee; Chicago Section Associate Committee.

[3] Chief engineer, Marvel Manufacturing Company, Chicago, Ill. Mem. ASME; chairman, Chicago Section Hospitality Committee.



1958 ASME Chicago Section Student Forum in action. *Left* to *right,* Prof. Roy Perkins, University of Illinois; Ernst Selig, Armour Research Foundation; Richard Engel, Westinghouse Electric Corporation; and John Ellis, Hanna Engineering Works, listen as Warren McConchie of The Air Preheater Corporation answers some of the questions about the engineering profession put to the panel by students.

appreciated by the students and had more meaning than a generalized discussion of all phases of the mechanical engineering profession.

The response of this educational service effort proved gratifying, and the Associate Committee has recommended to the Chicago Section that the student forum become an annual event. It should be well-organized and presented so that it may become a valuable and useful educational service to the engineering schools.

It should prove helpful to the student in making him realize what lies ahead for him when he commences his career in the mechanical engineering profession.

Copies of the Student Forum Report, "What the Engineer Does," may be obtained by writing to: Mr. R. H. Engel, Associate Committee, Chicago Section, The American Society of Mechanical Engineers, 84 East Randolph Street Chicago 1, Ill.

ACTIONS ASME EXECUTIVE COMMITTEE

A MEETING of the Executive Committee of the Council of The American Society of Mechanical Engineers was held in the rooms of the Society on Friday, Jan. 9, 1959. There were present: G. B. Warren, President; E. W. Allardt, L. N. Rowley, R. B. Smith, and A. W. Weber of the Executive Committee; A. M. Perrin and V. Weaver Smith, directors; E. J. Kates, treasurer; H. J. Bauer, assistant treasurer; L. C. Smith, chairman, Organization Committee; O. B. Schier, II, secretary; T. A. Marshall, Jr., senior assistant secretary; W. E. Letroadec and W. E. Reaser, assistant secretaries; J. J. Jaklitsch, Jr., editor; H. I. Nagorsky, controller; and D. B. MacDougall, associate head, Field Service.

Death of H. V. Coes. The Executive Committee noted with deepest sorrow the death on Dec. 4, 1958, of Harold V. Coes, Hon. Mem. ASME and President of the Society in 1943. The following represented the Society at Memorial Services: A. M. Perrin, W. A. Shoudy, J. C. Thompson, and Mrs. Roy V. Wright. A letter of tribute, to be prepared by G. A. Stetson for the President's signature, is to be sent to Mrs. Coes.

Blackall Machine Tool and Gage Award Fund. On Dec. 31, 1958, a check in the amount of $500 was received from The Blackall Foundation with the stipulation that this sum be added to the principal of the Blackall Machine Tool and Gage Award, bringing the grants to $9500.

Committee to Study the Effect of Inflation Upon Future Operations of the Society. In accordance with the action taken by the Council at the 1958 Annual Meeting, President Warren reported that he proposed to appoint the following as members of the Committee: F. B. Turck, chairman; L. E. Newman, John Amstuz, L. N. Rowley, L. W. Houston, with a member of the firm of Scudder, Stevens & Clark, the Society's financial counsel, acting in an advisory capacity.

Research Executive Committee. Three research agreements were approved with the University of Michigan. They include the following: (ASME Project 7-DP-9A), (ASME Project 7-SP-5), and (ASME Project 7-SP-6).

Affiliations. The Council approved the affiliation of the ASME Detroit Section with the Detroit Affiliate Council, and the affiliation of the ASME Pittsburgh Section with the Pittsburgh Affiliated Technical Societies at no expense to the Society.

Student Section. The Council approved the establishment of the Valparaiso University Student Section of ASME at Valparaiso, Ind.

Mechanical Engineering Department Heads. The Council approved the formation and objectives of the National Committee of Mechanical Engineering Department Heads under the Board on Education, and to refer the objectives to the Board on Education and the Constitution and By-Laws Committee for implementation.

ASME Transactions Depositories. The Secretary reported that as a result of the action taken by the Executive Committee of the Council, Oct. 3, 1958, 70 foreign depositories of ASME Transactions will be sent in January an application form with a letter of transmittal so that they may apply for certification as an ASME Transaction Depositor. Attention is called to the fact that MECHANICAL ENGINEERING also will be sent monthly to each of the certified depositories. The inclusion of MECHANICAL ENGINEERING was prompted by a recommendation from Messrs. J. W. Barker and R. B. Lea, who, as members of President Eisenhower's Person-to-Person Committee, found a great lack of technical information from the United States in the European and Middle East Countries which they visited during the summer of 1958.

Engineers Joint Council. The Society's representatives to Engineers Joint Council were directed to support any moves in the direction of an adequate budget for an expanded EJC operation.

The Engineering Institute of Canada. Committee to Rewrite International Agreement Between ASME and EIC. In accordance with the Report prepared by the Council Committee on EIC Relationship and accepted by the Council, June 14, 16, and 17, 1958, the President will appoint G. Ross Lord, J. David Carr, and Henry N. Muller, Jr., to meet with three members of the EIC to rewrite the International Agreement to contain "among other things, clauses stating the manner in which the Agreement is to be reviewed and amendments are to be made, and to contain a termination clause."

United Engineering Center. The Council discharged, with sincere thanks, the group appointed to develop a program for the Solicitation of Funds for the New United Engineering Center.

Certificates of Award. The Council authorized a special certificate for sixty-five years of membership in the Society for: Sterling H. Bunnell, Stratford, Conn.; and Percy H. Middleton, Waltham, Mass.

Certificates of Award were granted to the following retiring chairmen of Sections: C. G. Parker, Boston; L. R. Gensman, Oregon; J. W. Wasson, Hawaii; R. J. Sullivan, Central Illinois; Dennison Fairchild, Olean; D. M. Fox, Iowa-Illinois; W. E. Belcher, Jr., Philadelphia; T. H. Power, Sabine; R. A. Bowman, San Francisco; E. L. Anderson, Southern Tier; L. C. Smith, Susquehanna; and J. D. Melville, Waterbury.

Certificates of Award were granted to the following Section chairmen who served their Section prior to 1958: H. K. Clausen, Oregon, 1956–1957; W. E. Hammond, State Line Subsection, 1954–1955; F. O. Hennig, State Line Subsection, 1955–1956; A. W. Black, Olean, 1956–1957; A. K. Ingraham, San Francisco, 1956–1957; F. A. J. Brown, Susquehanna, 1955–1956; and K. W. Beattie, Susquehanna, 1956–1957.

Upon recommendation of Vice-President Sams, Region IV, a Certificate of Award was granted to N. W. Conner, secretary to Region IV, 1956–1958.

Upon initiation of his associates and approval of Vice-President A. W. Weber, a Certificate of Award was granted to R. W. Miller, a member of the Sections Committee of Region III from 1955–1958 and its chairman, 1957–1958.

Upon initiation of their associates and approval of the President, Certificates of Award were granted to the following Committee Chairmen: R. E. Derby, Professional Practice Committee, 1957 and 1958; and V. L. Doughtie, Engineers Registration Committee, 1958.

1958 Power Show. The Council authorized the crediting to the Research Reserve of the $14,500 received from the International Exposition Company, as a contribution from the 1958 Power and Mechanical-Engineering Exposition.

Nominations Wanted Now!

National Nominating Committee Stresses Democratic Procedure for Finding National Officers for ASME

DURING the 1959 Semi-Annual Meeting the National Nominating Committee will meet to choose nominees for President, Vice-President of Regions I, III, V, and VII, and for three Directors of the Society. You are reminded that the Nominating Committee can perform its function only if the Society members provide that body with the names of outstanding individuals for consideration.

These men, as officers of a $2-million corporation, should be leaders in their profession and in their community.

Each member of the Society no doubt is aware of one or more such leaders in his community, Section or Region—men who over the years have served the Society well and have helped to make ASME the world famed organization it is. It is your duty and privilege as a member to suggest such men for consideration as officers in the Society. Each ASME Section has an adviser on nominations who will see that your suggestions are forwarded to your Regional Nominating Committee Member. The latter or your Section Adviser will assist in the preparation of the nomination sponsorship form. If you do not have already the official Nominating Form you may secure such from Prof. William G. McLean, Secretary of the National Nominating Committee, Department of Mechanics, Lafayette College, Easton, Pa.

The National Nominating Committee will meet on June 15 and 16 during the 1959 Semi-Annual Meeting at the Chase-Park Plaza Hotel, St. Louis, Mo., to consider the prospective nominees. At this time, any member may appear before the Committee to advocate further the nomination of a candidate.

Ours is a democratic society. The caliber of national officers who will direct the affairs of our Society during the next one to four years is squarely up to you. Why not do something about it?

ASME Group Insurance Program Progress Report

THE Group Insurance Program which was first presented to members of The American Society of Mechanical Engineers in May, 1958, and which became effective June 1, closed its six-month Charter Enrollment Period on Dec. 1, 1958.

Several thousands of dollars in claims have already been paid to members and their families. The Committee on Group Disability Insurance for ASME Members which includes Edgar J. Kates, chairman; Arthur M. Perrin; and V. Weaver Smith, reports the following:

Members of the Society who have not yet enrolled can still apply. Applications will be subject to health requirements; however, about 90 per cent of the applications for the Program have met these requirements.

All parts of the Program have been well subscribed. The Major Hospital-Nurse-Surgical Expense Plan has proved most popular so far, having received about twice as many applications as the Loss of Time Plan. Older members also have responded well to the Senior Hospital-Nurse-Surgical Expense Plan.

Sixty-five per cent of the Major Hospital-Nurse-Surgical Plan applications were for coverage with no deductible amount, while 35 per cent of these applications requested coverage subject to a $500 deductible amount. Seventy-eight per cent of the members who applied for the Major and Senior Hospital-Nurse-Surgical Plans also requested coverage for a spouse and/or children.

Forty-two per cent of the Loss of Time applications were made for indemnity of $100 per week, 17 per cent for indemnity of $75 per week, 33 per cent for indemnity of $50 per week, and 8 per cent for the two associate Loss of Time Plans (available to members under 33) with indemnity of either $50 or $25 per week.

A special study was made by the Administrator of the Program of the first 1000 applications received to determine the relative use of the Program by various types of ASME members. It was ascertained that:

(*a*) One-third of all the applications were received from members in firms which employ ten or more ASME members. This ratio corresponds, within a few per cent, with the membership ratio itself. Since most of these firms, because of their size, may be presumed to have group insurance programs of their own, it seems clear that these members found it desirable to supplement their company coverage with some part of the Group Insurance Program for ASME Members. These members were probably also influenced by the fact that the coverage available under the ASME Program did not have to be dropped if they changed jobs.

(*b*) Government employees, educators, consulting engineers, and retired members use the Program in slightly larger proportion than their relative strength in the Society.

ENGINEERING SOCIETIES PERSONNEL SERVICE, INC [Agency]

These items are listings of the Engineering Societies Personnel Service, Inc. This Service, which co-operates with the national societies of Civil, Electrical, Mechanical, and Mining, Metallurgical, and Petroleum Engineers, is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

If you are interested in any of these listings, and are not registered, you may apply by letter or résumé and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular employment fee of 5 per cent of the first year's salary if a nonmember, or 4 per cent if a member. Also, that you will agree to sign our placement-fee agreement which will be mailed to you immediately, by our office, after receiving your application. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application to the employer and for returning when possible.

A weekly bulletin of engineering positions open is available at a subscription rate of $3.50 per quarter or $12 per annum for members, $4.50 per quarter or $14 per annum for nonmembers, payable in advance.

NEW YORK	CHICAGO	SAN FRANCISCO
8 West 40 St.	84 East Randolph St.	57 Post St

Men Available[1]

Chief Mechanical-Electrical Engineer, BS; 34; 12 years' design, production control, management, plant engineering, administrative engineering; experience in diesel and turbine and gas-compressor field; elevators and conveyers; food-equipment field. Prefers U. S., except South; Europe. Me-689.

Director of Research, BS, AB, MS; 18 years' professional experience directing, organizing, and controlling research in mechanical, electromechanical, and thermal fields; also consulting and academic experience. Recently created research division and recast entire product line. Three years' experience Europe. Prefers New York City. Me-690.

Plant Manager or Sales-Production Coordinator, BSME; 29; three years' sales-engineering experience pneumatic field; five years' general engineering and plant management in steel hardware. Looking for growth opportunities in plant-management field or as executive assistant. Prefers East, Midwest, West. Me-691.

Senior Design Engineer, Chief Engineer, BSME, PE; 59; ten years' chief plant engineer, supervision, engineering, maintenance, and construction; 15 years' design of chemical, steam and atomic energy power plants, paper, and other industries. Prefers U. S. or Canada. Me-692.

Sales Engineer, BSME; 32; four years' pump sales, four years' plant engineering, two years' safety and fire protection. Prefers East. Me-693

Director of Research and Development, BME, BEE, PE; 41; five years' electrical-mechanical development; 13 years' steel-mill-plant engineering supervision; three years' nuclear engineering management. Heavy experience machine design, operation, and maintenance. Cost control, proposals, and customer relations. Nuclear research-facility design and construction. Me-694.

Administrative Mechanical Engineer, BS; 32; ten years' manufacturing engineering including supervision 60-persons staff major automotive supplier covering equipment, materials, processes, quality control, metal finishing, materials handling. Full responsibility. Location open. Me-695.

Plant Manager, Plant Engineer, BSEE, 1949, MIE, 1952; 34; plant engineer, tires and associated products in S. A. Installation and maintenance. Supervised 50 people. Three years installation, instruction, and maintenance of knitting, dyeing, and finishing mill. Wool and cotton textiles, two years. No preference as to location. Me-842-San Francisco.

Corporate Planning Engineer, MBA, BSME; 28; PE, California; project engineer, chemical industry, three years; two years Corps of Engineers, Operations Staff and Company Officer. Economics, marketing, and finance at Stanford University Graduate School of Business. Prefers San Francisco Bay area. Me-756-San Francisco.

Systems Engineer, BSEE; 31; seven years' supervisory experience in engineering and quality control for electrical manufacturer. Systems experience in atomic equipment. Prefers California Bay area. Me-678-San Francisco.

Positions Available

Mechanical Engineer, Machine Designer, BME degree or equivalent experience. Should have three to five years' experience in design of high-speed, precision-production machinery. Must be able to carry out design investigations and follow projects through the design, development, and production stages. New ideas are required to create machinery for mass production of electronic components. Salary in line with applicant's experience and capabilities. Northern Pa. W-6566.

Engineers. (*a*) Mechanical engineer degree, about 15 years' experience, to supervise engineering department of manufacturer of power boilers. Must be thoroughly familiar with all the mechanical design problems and calculations. Duties will include close supervision of layout men, detailers, and checkers. (*b*) Chief design engineer, engineering degree, to take charge of design department for the manufacture of power boilers. Thorough knowledge of heat transfer and fluid flow essential. Must have extensive background in this field. Salaries open. Placement fees and moving expenses negotiated. East. W-6918.

Assistant Personnel Director, graduate mechanical or electrical, for large manufacturer, to handle college recruiting and relations with recognized universities. $12,000–$13,000. Boston, Mass., area. W-6923.

Instructor or Assistant Professor in the area of machine design and mechanics. Salary and rank dependent upon training and teaching experience. Consulting opportunities; graduate opportunities. Available September, 1959. Upstate N. Y. W-6940.

Design Engineers, degree in engineering, eight years' experience, including four years in responsible position, for design, layout, drafting, and writing specifications for heating, ventilating, and air-conditioning systems for buildings. Should have an interest in plumbing, electrical, and sprinkler trades as well as in heating, ventilating, etc. About $7500. Maine. W-6941.

Chief Engineer, mechanical or civil-engineering graduate, at least 10 years' supervisory project-design engineering and construction experience in combustion-equipment fields. $15,000. New York, N. Y. W-6945.

Manager of Development for a long-established manufacturer of a broad line of optical, mechanical, and electronic instruments and devices, principally for nonmilitary uses. Will direct a group of scientists and engineers in the design and development of new products and product lines as well as the redesign of existing products. Must have direct experience with optical instruments or electronic-optical equipment. Substantial salary, attractive incentive plan, and other benefits. East. W-6958.

Mechanical Development Engineers, advanced technical education in mechanical engineering and applied mechanics. (*a*) Senior engineer should have ten to 20 years' experience in the design and development of heavy machinery, rolling mills, and hydraulic presses. $12,000–$15,000. (*b*) Junior engineer should have five to ten years' experience in the same field. $9000–$12,000. Permanent positions with opportunity for advancement. Western Pa. W-6973.

Patent Engineer, mechanical-engineering training and at least five years' design, development, and patent-procedures experience, to prepare patent drawings and specifications covering pumps, valves, and controls. $7200–8400. Mich. W-6975.

---

[1] All men listed hold some form of ASME membership.

Sales Engineer, Gears, graduate mechanical, to sell helical and large gear trains. Must have some background in the design and application of large gears. $10,000–$12,000. East. W-6976.

Design Engineers, Industrial Hydraulics, graduate mechanical, broad knowledge of mechanical, hydraulic, and production engineering and four to six years' design experience in hydraulics or with related fields such as machine tools or other small-size precision products or mechanical devices (small power units, gear boxes, etc.). Good knowledge of mechanical-engineering principles, machine-shop practice, engineering methods and procedures, etc. Experience and interest in work on board as positions involve considerable board work. Work will involve layout design, testing, and test evaluation of industrial hydraulic components, including piston pumps, hydraulic transmissions, etc. $7,800–$10,800. Ohio. W-6982.

Research Liaison Engineer, technical degree (physics or electrical, mechanical, chemical, industrial engineering, etc.); broad knowledge of engineering more valuable than concentrated study. Five to six years' experience handling contact liaison and negotiation while working for government agencies concerned with screening and awarding research and development contracts, or similar experience with a company which does large volume of defense work. Reporting to the vice-president—Research, will be responsible for representing company research division in contacts with customers, government, etc. Will maintain current and detailed contact with all company research and the areas of friction materials, metallurgy, chemistry, hydraulics, controls, and bearings. $12,000–$15,000. Northern N. J. W-6983.

Chief Industrial Engineer, graduate, for multi-plant operations in the very heavy metal industry, including welding, machine shop, and foundry. Should have background in cost estimating, especially large job-shop costs. To $25,000. East. W-6989.

Sales Engineer, Large Machines, graduate engineer or equivalent, with an understanding of heavy machinery in particular, and familiarity with excavating machinery in general. Will do export sales work, selling products direct to customers in territories not covered by distributors; develop leads for new business and stimulate distributor's interest. Will assist purchasers in selection of equipment; co-operate with distributors in individual sales negotiations; develop new markets and expand present ones. $10,000, plus. Foreign travel about four months a year. Headquarters, Midwest. W-6996.

Industrial-Engineering Manager, IE or ME graduate, with at least five years' managerial and supervisory manufacturing engineering covering planning, production layout, methods improvement, and cost analysis in heavy industry including machining, forming, welding, assembly, and erection. Salary open. Midwest. W-6997.

Assistant Forging Plant Superintendent, graduate mechanical, industrial, or metallurgical engineer desirable, ten to 15 years' experience in precision forging work, preferably with high-temperature alloys and on parts used by aircraft-engine manufacturers; five to ten years' responsibility as forging superintendent, directing diemaking, forging, and polishing operations. Should have general knowledge of engineering and close familiarity with manufacturing methods required to produce precision forgings; specific knowledge of forging tools and dies. Will direct forging, machining, polishing, inspection, and testing of turbine parts in accordance with engineering, cost, quality, and delivery requirements. $15,000, plus bonus. East. W-7003.

Mechanical-Engineering Supervisor to head up department for small electronic components company in design of machines, methods of manufacture, industrial engineering, and repair and maintenance of machinery. $12,000, plus benefits. Upper N. Y. State. W-7009(*a*).

Engineers. (*a*) Consultant mechanical-system design, BSME, eight to ten years' experience with a majority of this in the appropriate field of effort in aircraft-gas turbines. Will provide mechanical-system-design consulting service and counsel to department personnel and airframe customers. $14,000–$18,450. (*b*) Consultant aerodynamics and thermodynamics, BSME, eight to ten years' experience with a majority of this in the appropriate field of effort in aircraft-gas turbines. Will provide aerodynamics and thermodynamics consulting service and counsel to department personnel and airframe customers. $14,000–$18,450. (*c*) Consultant control-systems

Keep Your ASME Records Up to Date

The ASME Secretary's Office depends on a master membership file to maintain contact with individual members. This file is referred to countless times every day as a source of information important to the Society and to the members involved. All other Society records are kept up to date by incorporating in them changes made in the master file.

The master file also indicates the Professional Divisions in which members have expressed an interest. Many Divisions issue newsletters, notices of conferences or meetings, and other material. You may express an interest in the Divisions (no more than three) from which you wish to receive any such information which might be published.

Your membership card includes key letters, below the designation of your grade of membership and year of election, which indicate the Divisions in which you have expressed an interest. Consult the form on this page for the Divisions to which these letters pertain. If you should wish to change the Divisions you have previously indicated, please so notify the Secretary.

It is highly important to you and to the Society to be certain that our master file indicates your current mailing address, business or professional-affiliation address, and interests in up to three Professional Divisions.

Please complete the form, being sure to check whether you wish mail sent to your residence or office address, and mail it to ASME, 29 West 39th Street, New York 18, New York.

- -

Please Print

ASME Master-File Information

Date

LAST NAME FIRST NAME MIDDLE NAME

POSITION TITLE NATURE OF WORK DONE

e.g., Design Engineer, Supt. of Construction, Manager in Charge of Sales, etc.

NAME OF EMPLOYER (Give name in full) Division, if any

*☐

EMPLOYER'S ADDRESS City Zone State

ACTIVITY, PRODUCT, or SERVICE OF EMPLOYER; e.g., Turbine Mfrs., Management Consultants, Oil Refinery Contractors, Mfr's. Representative, etc.

*☐

HOME ADDRESS City Zone State

☐

PRIOR HOME ADDRESS City Zone State

* CHECK "FOR MAIL" ADDRESS

I subscribe to

Address changes effective when received prior to:

☐ MECHANICAL ENGINEERING	10th of preceding month
☐ *Journal of Engineering for Power* ☐ *Journal of Engineering for Industry* ☐ *Journal of Heat Transfer* ☐ *Journal of Basic Engineering* ☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Professional Divisions in which I am interested (no more than *three*) are marked X.

☐ A—Aviation
☐ B—Applied Mechanics
☐ C—Management
☐ D—Materials Handling
☐ E—Oil and Gas Power
☐ F—Fuels
☐ G—Safety
☐ H—Hydraulics
☐ I—Human Factors Group
☐ J—Metals Engineering
☐ K—Heat Transfer
☐ L—Process Industries
☐ M—Production Engineering
☐ N—Machine Design
☐ O—Lubrication
☐ P—Petroleum
☐ Q—Nuclear Engineering
☐ R—Railroad
☐ S—Power
☐ T—Textile
☐ U—Maintenance and Plant Engineering
☐ V—Gas Turbine Power
☐ W—Wood Industries
☐ Y—Rubber and Plastics
☐ Z—Instruments and Regulators

design, BSME, eight to ten years' experience with a majority of this in the appropriate field of effort in aircraft-gas turbines. Will provide control-systems design consulting service and counsel. $14,050–$18,450. (*d*) Engineer, controls reliability, BS in engineering, five years in design and development of mechanical-hydraulic-type aircraft-control hardware. Will work with government agencies inside and outside the company to establish methods, procedures, and standards for analyzing and determining the reliability of control components and control systems. $12,600–$18,450. New England. W-7010.

Engineers. (*a*) Manager, facilities and maintenance engineering, BSME or BSCE, ten to 15 years' design and construction of test equipment; test maintenance; gas turbines. Will establish the requirements for and manage the operation of the subsection to provide for the design, procurement, construction, and equipment of test facilities and utilities. $14,050–$16,500. (*b*) Supervisor, facilities and utilities-design engineering, BSME or BSCE, five to ten years' of design and construction work; two to three years in providing knowledge of instrumentation involving mechanical and electrical applications. Will provide for the design and development of test and production equipment, facilities, etc. $10,400–$13,450. (*c*) Supervisor, facility instrumentation, BSME or BSEE, electronics background in either case; three to four years in facility instrumentation; fairly good understanding of engine and measurement problems involved. Will provide the calibration of all facility instrumentation. $9400–$11,125. New England. W-7011.

Engineers. (*a*) Supervisor, turbine mechanical design, BSME, four years in design and development of turboengine parts, preferably turbines, including design, parts procurement, and testing of engines or components, scheduling and coordination with manufacturing and testing organizations. $11,450–$15,200. (*b*) Supervisor, mechanical structures and configuration, BSME, or equivalent, four to six years airframe or engine design, to supervise activity of four to six design engineers. Will design static structural engine parts with complex shapes and thermal stresses. $11,450–$15,200. (*c*) Specialist, engine mechanical design, BSME or BSAE, three to five years in gas-turbine mechanical design; experience in programming and estimating of new engine proposals beneficial. $7890–$11,125. New England. W-7012.

Mechanical Engineer, PhD preferred, for teaching and research. Rank and salary commensurate with qualifications and experience. Eastern Canada. F-7013(*b*).

Mechanical Engineer or Physical Metallurgist, degree in mechanical or metallurgical engineering, experience in fuel burner or high-temperature boiler-design evaluation. Will involve a concentration of development problems for fuel burners. Will be responsible for studies of high-temperature materials and material properties at high-temperatures; will also develop fabrication techniques for materials subjected to high-temperature environment. Also included will be an evaluation of the physical properties of materials, heat transfer, and the effects of radiation. $8000-$11,000. Upstate N. Y. W-7015.

Systems Engineer, degree in mechanical or electrical engineering, or physics, experience in the analysis of system concepts; some familiarity with aircraft environmental-control systems or extensive laboratory experience on system controls. Will involve study and evaluation of new and novel air-conditioning systems; must be familiar with heat transfer, fluid flow, and controls. $7500–$9000. N. Y. State. W-7016.

Engineers. (*a*) Industrial engineer to assist general managers in an advisory capacity, in developing both plant and equipment budgets and operating budgets, develop organization manuals, administrative systems and procedures, conduct job-evaluation studies, conduct efficiency and other studies, as directed by the manager, planning administration. Fluent Spanish. Considerable travel to Central America. $9000–$10,000. Headquarters, New York, N. Y. (*b*) Planning engineer, mechanical or chemical, to assist general manager in planning operating policies, procedures, reports in the process-refining industry. Some travel may be involved. $6700–$8900. New York, N. Y. W-7022.

Chief Engineer, Mechanical, ten years' experience in design and construction of molds, tools, jigs, and fixtures, in custom molding or toy manufacturing. Working knowledge of thermoplastic materials required. Will have supervision of drafting and engineering departments, machine shop, product design. About $10,000. Prefer applicants from Mass. area. Mass. W-7030.

Industrial Engineers. (a) Chief industrial engineers, degrees in mechanical, electrical, or science courses, with training in work-factory-time standards. Some experience in electronic or metallurgical fields desirable but will consider men with experience in related industry, in industrial engineering or manufacturing engineering. $7000–$9000. (*b*) Industrial engineers, engineering degrees in mechanical, electrical, or science courses. Company is primarily in the electronic and metallurgical fields and would prefer men with experience in these fields. However, will consider applicants with three to five years' industrial or manufacturing experience. $4800–$6600. After training at main plant in Midwest applicants will be assigned to various plants throughout the U. S. W-7031.

Design and Development Engineer, graduate mechanical or electrical, three to five years' experience or its equivalent in training and experience, to work on electromechanical devices, with special emphasis on aircraft and industrial indicators. About $7000–$8500, plus fringe benefits. Company will negotiate placement fee. Conn. W-7034.

Manufacturing Engineer, graduate industrial or mechanical, five to ten years' experience, to improve production methods and capacity of a chemical-mechanical operation. Duties will involve investigation of equipment, manning, instrumentation, and automation; must be able to work effectively with production, technical, and engineering departments. $7200–$9000. Southern Conn. W-7035.

Engineers. (*a*) Production-control manager, degree either in engineering or business administration; a minimum of seven years' experience in production control, three years of which must have been in supervision. Some business-machine experience desirable. Must have knowledge of systems and experience and knowledge in the application of IBM to inventory and production control. Will direct and co-ordinate the production control section to insure optimum utilization of capital equipment and labor forces to meet sales requirements and proper inventory balance. $7500–$10,000. (*b*) Quality-control manager, graduate industrial, mechanical, or electrical, minimum of seven years' experience in inspection and quality control, three years of which must have been in supervision; must know layout; tool and gage inspection and electric, as well as electronic, instrumentation; must have working knowledge of statistics as applied to quality control. Will direct and co-ordinate the quality-control section to attain and maintain company's objectives with regard to quality of product. $7000–$9000. Placement fees and relocation expenses paid. New England. W-7046.

Assistant or Associate Professor in mechanical engineering. Master's degree required. Opportunity includes responsible charge of the mechanical-engineering laboratories with teaching in the heat-power field. Rank and salary commensurate with experience. East. W-7053.

Product Manager for machinery-sales department; mechanical or chemical graduate; seven to ten years' experience, including field sales. Must be familiar with chemical processing and machinery or equipment used in unit operations; direct sales, marketing, or promotion experience. Major responsibility will be in sales and sales development in new markets of established machinery item and new product. Duties will include sales promotion, market development, pricing, field stimulation, engineering co-ordination on new or established machinery products. Salary commensurate with qualifications. Upstate N. Y. W-7054.

Engineer, at least bachelor's degree in mechanical engineering, associated engineering sciences, or physics; experience either in an industrial organization or government service along the lines of materials engineering, product engineering, design, or as an information officer in guided missiles and rockets or related experience. Will work with a group whose interest includes deterioration of materials and equipment and its prevention. Some travel; security clearance through "Secret" required. $7000–$7500. East. W-7055.

Design Engineer, graduate mechanical preferred, experience in the design of automatic or special machinery essential. Typical experience would be as a machine designer on packaging, metal stamping, food processing, plastic-forming machinery, or similar types of mechanism. Will plan and perform design-engineering assignments on major projects involving new equipment or modification to existing equipment. $8500–$10,000. New England. W-7056(a).

Chief Acoustical Engineer, graduate mechanical, practical experience in research and development involving noise-suppression devices and their applications. Previous administration of a department and knowledge and experience in project handling and manufacturing methods. Will be in charge of all silencer-engineering research and development programs involving metal noise-suppression devices. Will evaluate progress and results and recommend major changes in procedures and objectives. $14,000. New England. W-7057.

Process Engineer, graduate mechanical, practical experience in manufacturing as a process engineer, particularly on welding. Knowledge of welding codes. Will study, investigate, and recommend improvements to existing welding methods and procedures. Review manufacturing operations related to use of sheet metal in order to reduce cost and improve efficiency; recommend changes in design and construction when required. $8000–$9500. New England. W-7059.

Engineers. (*b*) Mechanical-design engineers, experience on small precision parts, instruments. (*c*) Mechanical engineer to set up and develop a pilot plant for precision instruments and small parts assembly. $10,000–$12,000. Mass. W-7060.

Machine Designer, graduate mechanical, minimum of five years' board experience. Work will be on design of special machines and tooling used in forming operations on light-gage metal. Must be able to carry through on assigned projects in translating new ideas into workable equipment; should have strong interest in practical manufacturing problems. $7000–$9000. Conn. W-7064.

Inside Sales Engineers, graduate mechanical, with some related experience with pumps and worm gears desirable but not necessary. Will assist in compiling and collating technical details involved in preparation of sales-engineering data for submission to prospective customers; assist in detailed aspects of preparation of propositions, establishment of material specifications, etc. To start, $4784–$6292. N. J. W-7066.

Field Engineer, graduate electrical or mechanical, five to ten years' experience; proved sales ability in air data and inertial subsystems and components. Territory, eastern U. S. Headquarters, New York, N. Y. W-7075.

Estimator, Steel Plate, Tanks, mechanical graduate or equivalent, experienced estimator able to do some drafting, design, and shop detailing; to take off from customers' drawings and experienced to meet clients. Must know ASME code on pressure vessels and should have some shop experience in heavy steel-plate work for steel-fabricating shop. $9000, plus benefits. San Leandro, Calif. S-4058.

Plant Engineer, Food Process, mechanical background; well-experienced in process plant and maintenance; knowledge of conveyer and bulk, process, packaged materials (raw or cooked), industrial equipment, hot or cold temperature, fans, pipe, steam and water; must have previous substantial experience and be able to conceive special design machines and equipment and be able to draft plans. Report to plant manager; multiplant operation. About $8400. Idaho. S-4061.

Construction Manager, preferably graduate engineer, good experience as construction superintendent or engineer on pipe lines, refineries, or heavy industrial jobs and able to co-ordinate and administer four or five jobs for joint venture of American contractors. Twelve to 18 months or better. $18,000–$20,000. Middle East. S-4066.

Industrial Engineer, Metal Manufacturing, BSME, industrial engineering; experience in shop methods for machinery, forming, welding, and assembling operations. Will plan, schedule, and control incoming orders for production and delivery on time required by customers. $6000–$7200, to start, plus bonus. San Francisco East Bay. S-4071.

Industrial Engineer, Consultant, engineering degree, several years' experience, to make surveys and set up procedures for client companies in Scandinavian countries. Salary open. S-4075.

Designer, Pumps, ME, able to perform office-design-board work and shop duties relating to usage, application, and manufacture of pumps including mounting, coupling, drafts, and selection of proper equipment for specified usage; also to modernize mechanical arrangements and able to select appropriate equipment and materials for special or standard usage. $7200–$7800; excellent promotional possibilities. San Francisco. S-4076.

Designer, Machinery and Mechanisms, mechanical graduate, minimum of five years' creative drawing-board designs of machines, apparatus, or equipment (machine tools, engines, specialized automatic machinery) and ability to prepare manufacturing and fabrication details; practical ability within plant limitations, cost, methods, and process; some background in thermodynamics helpful; able to advise and consult with supervisors and management. For manufacturer and fabricator of medium and heavy commercial equipment. $9600–$9900. Ore. S-4083.

Engineering Designer, Heating and Ventilating, degree or equivalent, minimum of three years' experience in heating and ventilating, air conditioning and/or plumbing; must be well experienced and able to perform independently on job and commercial-type work including schools and hospitals. Able to translate design thinking into board plans. Employer will consider payment of relocation cost and placement fee. $7800–$9000. Headquarters, Sacramento, Calif. S-4090.

Designer, Cranes, preferably mechanical graduate, overhead crane experience, capable of supervising the structural and mechanical design departments. Will be considered in near future as chief engineer if qualified. Salary open. Northwest. S-4098.

Designer, Conveyers, mechanical-graduate preferred, three to five years' experience on design of package-handling conveyers, to work on design and details of automatic package-conveyer systems. Must know structures, mechanisms, and controls (mechanical—electronic). Responsible for project after breaking-in period. $7200–$7800, possibly more. Employer will discuss payment of placement fee. San Francisco Peninsula. S-4107.

Design, Development, Small Mechanisms, mechanical-engineering graduate, minimum of five to ten years' experience in mass production of small mechanisms with mechanical operating knowledge extending into relays manufacture. Should have good electromechanical engineering background with knowledge of actuating mechanisms for switching, electrical contactors, contact pressures, vacuum enclosures. Able to work with research department and do board work as required. $8700–$10,800. Santa Clara County, Calif. S-4116.

Plant Engineer, BSME or equivalent, ten years in plant engineering and maintenance of buildings and equipment. Know process equipment, piping, wiring, steam generation, refrigeration, materials handling, packaging. Will be in complete charge of all plant-engineering work in branch plant of leading company in brewing industry. Responsible for annual capital expenditures, maintenance of buildings and equipment, operation of steam-generating plant, and refrigeration system. Emphasis on high maintenance and performance standards in bottling and shipping departments. Must be high-caliber man with strong administrative ability and able to advise plant manager on all technical matters of plant operation. $9000–$12,000. Employer will pay placement fee. Cleveland, Ohio, or East. C-7232.

CANDIDATES FOR MEMBERSHIP AND TRANSFER IN ASME

The application of each of the candidates listed below is to be voted on after March 25, 1959, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and •Transfers

Alabama

Davis, Billy K., Florence
●Hendrix, Jack W., Huntsville

California

Anderson, John W., Fullerton
Applegate, William H., Richmond
Bell, Bruce A., Los Alamitos
Bouse, George B., Los Angeles
Ferguson, Andrew W., Los Angeles
Kraft, Thomas L., Los Angeles
●Matosec, Jerome M., Whittier
Powell, Carl A., Stockton
Richter, Hans L., Sau Gabriel
Russell, John O., Van Nuys
●Secord, Terrence C., Downey
●Seipel, Wilbur M., Lancaster
Zinn, Donald V., Fresno

Colorado

●Reed, Glenn D., Wray
Waselkow, Charles, Denver

Connecticut

Beattie, John M., So. Norwalk
Carissimi, Vincent L., Fairfield
Danielson, Lincoln V., New Britain
Ratkiewich, Lois, Hartford

Florida

Branning, Charles E., Riviera Beach
Edson, David A., Melbourne
●Flanigan, Frank M., Gainesville
Young, Frank F., Panama City

Georgia

Pierce, Ronald C., Savannah
Taulman, John M., Atlanta

Hawaii

Appel, George F. B., Jr., Honolulu
●Bolte, Frederick, Honolulu

Illinois

Carson, John H., Anna
Chiapetta, Richard L., Chicago
Chinn, Rollin J., Chicago
Devine, Miles J., Chicago
Livingston, Richard D., Rockford
Neumann, Charles G., Palatine
Nordstrom, Harrison B., Jr., Chicago
Norton, Herbert F., Robinson
O'Neill, Robert G., Franklin Park
Sagula, Frank J., Chicago
Weber, Ronald C., Chicago

Kansas

●Sanderson, Leroy F., Salina
Suptic, John M., Shawnee

Louisiana

●King, William F., New Orleans
Ory, Antoine I., Jr., New Orleans
Rittiner, Lloyd J., Metairie
Vivien, Leo J., New Orleans

Maryland

Auth, Henry J., Jr., Frederick
●Beasley, Elmer G., Jr., Rockville
●Campbell, Charles E., Silver Spring
Lane, Delford L., Elkton

Massachusetts

Dugan, Walter J., Fitchburg
Epstein, Charles, N., Westfield
●Fowle, Arthur A., Winchester
Humphreys, John S., Cambridge
Sinclair, Stuart E., Greenfield
●White, Colin S., Springfield

Michigan

Clark, William W., Saginaw
●Fletemier, Marvin O., Plymouth

Minnesota

Martell, Harrison J., Rochester
Johnson, Floyd R., Rochester

Missouri

Klumb, David L., St. Louis

New Jersey

●Banks, Alfred J., Fanwood
Borkmann, Frank F., Union
Davis, William F., Hightstown
Dieffenbach, Philip A., Jersey City
Gebbia, Louis L., Passaic
Hoermann, Robert H., Verona
Howell, Fred M., Ramsey
Olender, Francis B., Wallington
Sisto, Fernando, Jr., Hoboken
Toto, Robert N., Oak Ridge

New York

Baumann, William H., Utica
●Chen, Alwin C.H., New York
Contini, Renato, New York
Engelhard, Otto, Forest Hills
●Gude, John W., Chatham
Konkol, Peter A., Schenectady
Lasher, Robert W., New Hartford
●MacDuff, Edward J., Wellsville
Malin, Leon, White Plains
Mattson, Peter R., Schenectady
●Michalec, George W., Pleasantville
Mow, Chao C., Troy
Nissan, Alfred H., Troy
Parks, Ralph B., New York
Rinkewich, Isaac R., Brooklyn
Risher, Paul D., New York
Schneider, John E., Groton
Schubert, Douglas D., Buffalo
Severino, Jean V., Valley Stream
Steiner, Edward, Flushing
Stribling, John W., New York
Treff, Ernest H., Whitestone
Wallace, Edgar C., Watertown

North Carolina

Altvater, Hubert M., Greensboro
Stephenson, Harold P., Durham

Ohio

Baturka, Walter, Cleveland
Blewitt, Frederick R., Youngstown
Blodgett, Omer W., Cleveland
Bone, Kendall F., Cincinnati
Botje, Jacobus M., Cincinnati
●Crawford, Joe H., Cincinnati
Deibel, David L., Cleveland
Felty, David N., Jackson
●Gibb, James R., Cincinnati
Green, Robert S., Worthington
Kaut, George A., Portsmouth
Longabaugh, John R., Jr., Columbiana
McEvoy, James E., So. Euclid
McEvoy, William E., Struthers
●Melcher, Frank T., Cleveland
Pierce, Robert N., Columbus
Sepsy, Charles F., Columbus
Zelenka, Donald B., Akron

Pennsylvania

Boettcher, Harry H., Allentown
●Boyum, William B., Allentown
Craig, William J., Monroeville
Lynch, Joseph R., Canonsburg
Matsch, Lee A., Pittsburgh
Maybach, Gunter W., University Park
Muthuswami, Periannagounder, Pittsburgh
Reinking, Robert F., Tamaqua
Williams, Edwin C., Newtown Square

Puerto Rico

Morales, Emilio J., Mayagüez

Rhode Island

Chafee, Edwin W., Riverside

South Carolina

Grant, Van W., Aiken

Tennessee

Parker, William S., Chattanooga
Quade, Robert N., Chattanooga

Texas

Adams, William W., Jr., Houston
Amundsen, Ernest W., Fort Worth
Erwin, Leroy E., Fort Worth
Golden, Billy G., Richardson
Hodges, Marvin, Jr., Port Arthur
●Johnson, Ray A., Dallas
Kent, Harry L., Austin
●Millis, William C., Dallas
Nelson, Roy F., Port Arthur
Sheaffer, Walter H., Texas City
Willis, James E., Jr., Baytown

Vermont

Durland, Philip C., Springfield

Virginia

Coudriet, Edward A., Richmond
Cross, Wilby E., Jr., Richmond

Washington

Nickerson, Donald K., Seattle

West Virginia

Vickers, Delmar C., Carbon

Wisconsin

Goham, James E., Cudahy
Lucey, Ray E., La Crosse
Matkovich, George, Milwaukee

Foreign

Ali, Ch. Z., Karachi, West Pakistan
Allen, Robert W., Stockport, Cheshire, England
Boyd, Robert W., Toronto, Ont., Canada
Cavallaro, Leonardo, Rome, Italy
Cyr, William H., Montreal, Que., Canada
Day, Richard F., Burlington, Ont., Canada
●Desrochers, Fernand C., Baie d'Urfee, Que., Canada
Fugade, Filadelfo, Jr., Agana, Guam
Garg, Vinod K., New Delhi, India
Hall, James, Hamilton, Ont., Canada
Majano, Bernardo L., Oviedo, Spain
Narsted, George L., Montreal, Que., Canada
Smith, Eric M., Glasgow, Scotland
Vasquez, Juan A., Caracas, Venezuela

● Transfer to Member or Affiliate.

OBITUARIES

Allan Hayden Baxter (1886-1958), partner, A. E. Baxter Engineering Co., Buffalo, N. Y., died Nov. 24, 1958. Born, Milwaukee, Wis., Feb. 13, 1886. Parents, Alfred E. and Ellen A. (Hayden) Baxter. Education, ME, Cornell University, 1908. Married Emily Dows, 1910; children, Edward Dows, Hilda Emily, and Henry Hayden. Mem. ASME, 1927. Mr. Baxter was a specialist in the design of grain-handling plants, flour-feed mills, storage elevators, warehouses, and docks. He was a registered professional engineer in the States of Maryland, New Jersey, New York, Ohio, and Vermont.

Frank Eugene Burpee (1872-1958), professor-emeritus of mechanical engineering, Bucknell University, died Nov. 29, 1958, in Lewisburg, Pa. Born, Beloit, Kan., May 16, 1872. Parents, Nathan L. and Mary (Gifford) Burpee. Education, AB, Bucknell University, 1901; MA, 1902; hon. DE, John B. Stetson University. Married Pearl L. Smith, 1905 (died 1949). Mem. ASME, 1914. In 1912 he was made professor of mechanical engineering at Bucknell and for 25 years he taught and also supervised the university's buildings and grounds. In 1937 he retired from teaching to devote full time to the newly created position of superintendent of buildings and grounds. He held that post until 1944. Although Bucknell's rapidly expanding plant occupied most of his time, Professor Burpee took an active part in civic as well as college affairs. He served as president of the Lewisburg Borough Council and twice was made burgess of the community. Surviving are a daughter, Mrs. John Kinnsloe; a son, Stanley Burpee; three sisters; and four grandchildren.

Alexander Bowden Carr (1901-1958), lecturer, Mechanical Technology Division, Ryerson Institute of Technology, Toronto, Ont., Canada, died June 10, 1958. Born, South Hetton, Durham, England, Jan. 24, 1901. Education, studied electrical engineering, Armstrong College, Durham University. Mem ASME, 1949. Mr. Carr had been a specialist in the field of aircraft hydraulics and aircraft shock absorbers. He held a British patent for a slide rule, and was the author of charts for simplified calculations on spring design. He was a registered professional engineer in the Province of Ontario. Survived by his widow, Mary A. Carr.

Harold Vinton Coes (1883-1958), past-president, Hon. Mem. ASME, and retired director and vice-president, Ford, Bacon & Davis, Inc., New York, N. Y., died Dec. 4, 1958. Born, Hyde Park, Mass., June 21, 1883. Parents, Zorester Bennett and Alice (Miller) Coes. Education, BS, Massachusetts Institute of Technology, 1906; and Alexander Hamilton Institute. Married Agnes Wickfield Day, 1909; two sons, Kent Day and Harold Vinton Coes, Jr., Assoc. Mem. ASME, 1907; Mem. ASME, 1913; Fellow ASME, 1936; Hon. Mem. ASME, 1950. Mr. Coes had been with Ford, Bacon & Davis, Inc., since 1919 with the exception of four years when he was director, vice-president, and general manager of the Belden Manufacturing Co. In 1928 he returned to Ford, Bacon & Davis as manager of the industrial department. In 1937 he became a partner in the firm, and in 1941, vice-president. On behalf of that firm he engaged actively in the management of several industrial concerns, among them the Platt Iron Works and the Vulcan Iron Works. His activities have been largely in the field of industrial management and industrial engineering and have included reports, studies, and investigations of a wide variety of industrial plants. In 1946 he was consulting engineer to the planning and development board of the Government of India. Three years later he served in Paris as deputy director and acting director of the industrial department of the Economic Cooperation Administration. He served also as an adviser to Massachusetts Institute of Technology and to the engineering departments of Princeton and Columbia Universities. Mr. Coes was the author of many papers on economics, management, and industrial and marketing subjects; they include "Production Control"; the handling materials section of "Cost and Production Handbook"; "Depreciation and Obsolescence," and "The Business Survey," sections of the AMA Handbook. He had been an active member of the Society since 1907, serving as a manager, 1929-1932; as a vice-president, 1927 and 1932-1934; and president, 1943. His committee work includes service on the Professional Divisions Committee, the Materials Handling Division, as chairman, Budgeting Policy Committee, the Special Committee of Depreciation, and the Special Committee on War Production. In 1927-1928 he served as vice-chairman of the Chicago Local Section. He represented the ASME on the board of the United Engineering Trustees, Inc., serving as president and as chairman of the organization's finance committee. He was also one of the Society's representatives on the Engineers' Defense Board. Other organizations with which he was affiliated include: AMA; director, Engineering Index, Inc.; past-president, Association of Consulting Management Engineers; SAM; NAM; and AOA. For the Seventh International Management Congress, he was vice-chairman of the Finance Committee. Survived by his widow, Mrs. Agnes Day Coes, and two sons. (See also "Editorial," MECHANICAL ENGINEERING, January, 1959, p. 25.)

Harold Shields Dickerson (1880-1958), retired manager, The Pure Oil Co., Columbus, Ohio, died Nov. 24, 1958. Born, Grand Rapids, Mich., July 9, 1880. Parents, Wilbur and Melissa R. (Wells) Dickerson. Education, BS(EE), University of Michigan, 1905; BS(ME) and ME, Purdue University, 1911. Married Genevieve Roblee, 1904; one daughter, Margaret Lois (Mrs, George H. Hopkins). Mem. ASME, 1912. Mr. Dickerson had been with the Pure Oil Co. from 1928 to his retirement in 1945. He was a past-chairman of the Chicago Section ASME, and had been a member of the Executive Committee of the Columbus, Ohio, Section. Survived by his widow and daughter.

George Munro Forrest (1878-1958), retired management engineer, New York, N. Y., died Oct. 18, 1958. Born, Halifax, N. S., Canada, Oct. 27, 1878. Education, BS, Dalhousie University, Halifax, N. S., Canada; CE, Cornell University, 1902. Married Agatha McLeod. Mem. ASME, 1912. Mr. Forrest had been engaged in a consulting practice since 1929. He was one of an ASME Committee appointed to prepare a short biography of Fred J. Miller, past-president ASME. Among his other works was a "Life of Henry L. Gantt."

Lewis De Witt Freeman (1888-1958), trustee, New York, Ontario & Western Railway, Middletown, N. Y., died Jan. 11, 1958. Born, Gettysburg, Pa., July 11, 1888. Education, attended Gettysburg, Pa., High School and ICS. Assoc. Mem. ASME, 1913; Mem. ASME, 1925. Mr. Freeman was a specialist in the field of railway mechanical equipment and maintenance. He is survived by his widow.

Charles Bennett Karlson (1889-1958), president, Steel Products Corp., New York, N. Y., died Nov. 27, 1958. Born, Cambridge, Mass., June 23, 1889. Parents, Charles William and Charlotte Susan Karlson. Education, BS(ME), Lowell Institute of Technology, 1911; General Electric Engineering School, Lynn, Mass. Married Mildred Sawyer, 1915; daughter, Alice Karlson. Assoc. Mem. ASME, 1922; Mem. ASME, 1935. Before joining the Steel Products Corp. in 1926, Mr. Karlson had been with the U. S. Navy Department, Worthington Pump and Machinery Corp., and B. F. Sturtevant Co. Member also ASTM.

Charles Franklin Kettering (1876-1958), 1940 ASME Medalist, 1944 John Fritz Medalist, formerly vice-president, director, and general manager, Research Laboratories Division, General Motors Corp., Detroit, Mich., died Nov. 25, 1958. Born, Loudeville, Ohio, Aug. 29, 1876. Parents, Jacob and Martha (Hunter) Kettering. Education, Ohio State University, 1904; 32 honorary degrees. Married Olive Williams, 1905 (died 1946). Mem. ASME, 1915; Fellow ASME, 1946. Began his career with Star Telephone Co., Ashland, Ohio, and then went to the National Cash Register Co. In 1904 produced the first electric cash register. With Edward A. Deeds, Affiliate ASME, in 1909, he organized the Dayton Engineering Laboratories Co. (Delco) where he developed the automatic self starter and the Delco farm light. In 1916 Mr. Kettering and Mr. Deeds sold their interest in the Delco starting, lighting, and ignition system to the United Motors Co. now General Motors Corp.; and established the Dayton Research Laboratories. In 1920 the laboratories were taken over by GM. His many important inventions and discoveries would fill volumes. A brief list includes: the self starter, lighting, and ignition systems; electrified cash register, credit systems, and accounting machines; small generating unit for lighting farmhouses; originated and guided researches resulting in higher octane gasolines; improved automobile finishes; nontoxic and noninflammable refrigerant; and improved diesel engines. At one time he was chairman of the National Inventors Council. He was a director of the National Cash Register Co., the Ethyl Corp., the Mead Corp., and Moraine Development Co.; was chairman of the board, Winters National Bank and Trust Co., and Flexible Co. In 1927 he founded and financed the Charles F. Kettering Foundation and has since served as chairman of the board giving active direction to researches in natural sciences including work on chlorophyll and photosynthesis, artificial fever therapy, and cancer; president, Thomas A. Edison Foundation; director, Sloan-Kettering Institute for Cancer Research; co-founder, Moraine Park School. He was a trustee of the following colleges and universities: Ohio State, Wooster, University of Miami, Southern Research Institute. He had been honored by civic organizations, professional societies, and institutions of higher learning alike; among his honors were: The Sullivant Medal (1929); the Washington Award (1936); the Jean Scott Memorial Award (1936); the Franklin Gold Medal (1936); a Chevalier of the French Legion of Honor (1937). In addition to membership in numerous technical and professional societies and organizations, he was a member also of Tau Beta Pi and Sigm Xi. Survived by his son, Eugene W. Kettering, and three grandchildren. See also "Editorial," MECHANICAL ENGINEERING. January, 1959, p. 23.

Terry Joseph McLaughlin (1934-1958), design engineer, Food Machinery and Chemical Corp., Ordnance Division, San Jose, Calif., died Nov. 10, 1958. Born, Rockford, Ill., Nov. 1, 1934. Parents, Earl J. and Ruth (Seidel) McLaughlin. Education, attended Rockford College, 1954; BS(ME), Illinois Institute of Technology, 1958. Married Nancy Wilson, 1957. Assoc. Mem. ASME, 1958. Member Pi Tau Sigma.

Howard Nadin Moody (1882-1958?), consulting engineer, New Orleans, La., died recently according to a report received by the Society. Born, New Orleans, La., April 16, 1882. Education, studied at Whitehead College, Winston-Salem, N. C. Mr. Moody had been a specialist in power-plant construction and heating. Assoc. Mem. ASME, 1920; Mem. ASME, 1935.

Charles M. Muchnic (1877-1958), a former director in and consultant to the United Engineering and Foundry Co., Pittsburgh, Pa., died Nov. 20, 1958. Born, Odessa, Russia, March 17, 1877. Education, graduate, Drexel Institute, 1896. Mem. ASME, 1927. Mr. Muchnic was at one time a vice-president of the American Locomotive Sales Corp. During World War I, while with the company, he played a part in the sending of railway equipment and personnel to the aid of the Russian government before the Bolshevik Revolution. After World War I, he was decorated by the Italian government for his work in the war. Survived by his widow, Edna Smith Muchnic.

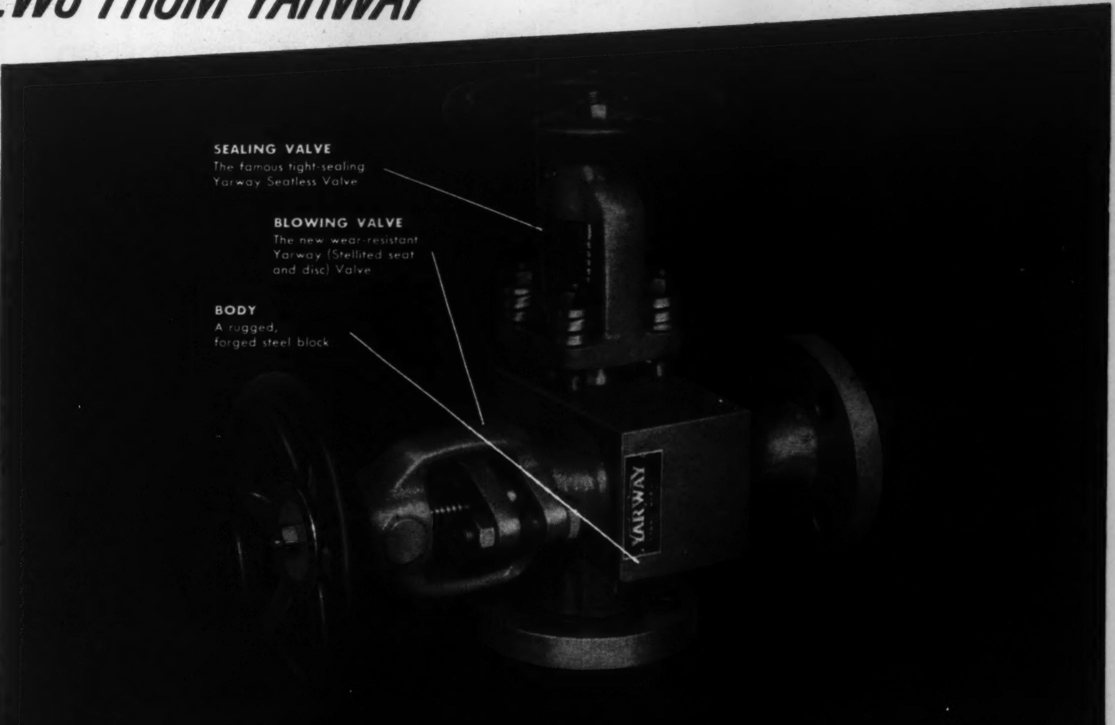
David Nabow (1894-1958), vice-president and chief engineer, Duke Power Co., Charlotte, N. C., died Nov. 30, 1958. Born, Russia, Nov. 15, 1894. Education, BS(CE), Columbia University, 1916. Mem, ASME, 1941; Fellow ASME, 1954. Mr. Nabow had been active in the economical design of large steam-electric and hydroelectric generating stations with the Duke Power System since 1925. He had been chief design engineer or consultant in the construction of 26 hydroelectric and steam installations in the U. S. and Canada. They include the 360,000-kw Isle Maligne Hydro-Electric Plant (Canada) and the 665,000-kw Riverbend Steam Plant of the Duke Power Co. He was the author of a paper on the design of the latter. He was recipient of the 1950 Award of the North Carolina Society of Engineers for outstanding achievement. Mr. Nabow was a registered professional engineer in the States of North and South Carolina. He held a patent for large rectangular-type butterfly gates.

Howard Prescott Quick (1865-1951), whose death in April, 1951, has recently been brought to the attention of the Society, had been a consulting engineer, Westfield, N. J. Born, Seymour, Conn., Aug. 6, 1865. Education, attended New York University; BP, Brown University, 1887. Mem. ASME, 1894. Mr. Quick was among the early designers and constructors of steam and electric railways and power plants and systems in the U. S. and foreign countries. His association with early engineering achievements include the following: the first electric railway system, Boston, Mass., 1889; the Niagara River hydroelectric plants of 132,000 hp; a system of hydroelectric plants, dams, and transmission lines near Barcelona, Spain, and in the Pyrenees. He was the author of a number of articles published in technical journals and the technical press.

Waldo Leonard Sherman (1889-1958?) whose death recently was made known to the Society, had been retired secretary and treasurer, John Robertson Co., Inc., Brooklyn, N. Y. Born, Harrisville, R. I., Jan. 16, 1889. Parents, Everett B. and Alice (White) Sherman. Education, BS, Worcester Polytechnic Institute, 1912. Married Vona Mellen, 1916; one son, Gordon Leslie Sherman. Assoc. Mem. ASME, 1916; Mem. ASME, 1925. Mr. Sherman had been with the Robertson firm since 1924.

Guy Ashley Voorhees (1887-1958?), consulting engineer, Monrovia, Ind., died recently according to reports received by the Society. Born, Canton, Ill., Dec. 29, 1887. Parents, Oscar and Ella (Brokaw) Voorhees. Education, high-school graduate. Married Okel M. Bly, 1922. Mr. Voorhees had been coauthor of sections of "Practical Warm Air Heating" issued by the National Warm Air Heating and Air Conditioning Association. Member also American Society of Heating and Ventilating.

NEWS FROM YARWAY


SEALING VALVE
The famous tight-sealing Yarway Seatless Valve
BLOWING VALVE
The new wear-resistant Yarway (Stellited seat and disc) Valve
BODY
A rugged, forged steel block
YARWAY

NOW! A NEW YARWAY UNIT TANDEM BLOW-OFF VALVE FOR MEDIUM PRESSURE BOILERS

There's a new star in the Yarway Blow-Off Valve line.

For years rugged Yarway Unit Tandem Blow-Off Valves have been standard equipment on most high pressure boilers. In fact, more than 80% of high pressure plants use Yarways.

Now a *new design* Unit Tandem is offered for *medium pressure boilers to 665 WSP*. Streamlined, lighter in weight, easy to operate, tight sealing and long wearing—this valve brings premium quality Yarway Unit Tandem dependability to the medium pressure field—*at a competitive price!*

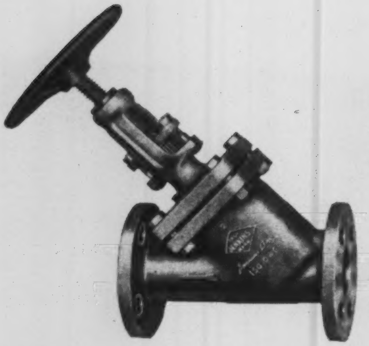
Important features, like the nitralloy plunger in the sealing valve and integral stellite seat and disc in the blowing valve, make this your best buy for blow-off service.

Order Yarway Unit Tandems for your present boilers—or specify them on new boilers.

For full details write for Yarway Bulletin B-435, Supplement A.

YARNALL-WARING COMPANY
108 Mermaid Avenue, Philadelphia 18, Pa.
BRANCHES IN PRINCIPAL CITIES

YARWAY®



A Y Globe that challenges comparison shows it pays to

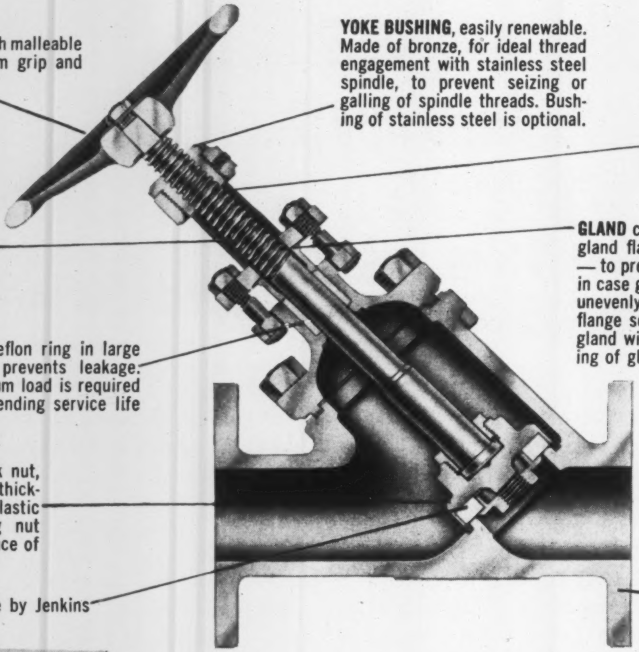
Specify JENKINS for STAINLESS STEEL Valves, too

Want the "best buy" in Stainless Steel Y Globe Valves? Compare this Jenkins Fig. 1335 with any on the market. You'll conclude that it's hard to beat Jenkins at making valves, no matter what the material.

You'll find genuine superiority of design and construction in the features shown here. But no picture can show the quality of the castings . . . the precision machining . . . the rigid inspection and testing that have gone into this valve. All of these are as important as design and metal alloys in assuring long, dependable, economical valve service. And, all of them are up to the peak standards for which Jenkins has been known for almost a century.

SEND FOR NEW CATALOG of Jenkins Stainless Steel Valves, in patterns and alloys that satisfy the requirements of practically all corrosive services.

These Jenkins Valves meet valve industry specifications and the high standards established by leading users of stainless steel valves.



WHEEL of high strength malleable iron designed for firm grip and easy operation.

SPINDLE of large diameter and dense structure has high resistance to wear and torsion strains. Easy, tight closing is assured by long, precision machined thread bearing surfaces. A beveled shoulder provides backseating against inside of bonnet, permitting repacking under pressure.

PACKING A Teflon ring in large packing box prevents leakage. Only a minimum load is required on gland, extending service life of packing.

DISC HOLDER, held by lock nut, has depth equal to disc thickness, preventing flow of plastic disc. Wide disc retaining nut covers all but seating surface of Teflon disc.

DISC is Teflon made by Jenkins

YOKE BUSHING, easily renewable. Made of bronze, for ideal thread engagement with stainless steel spindle, to prevent seizing or galling of spindle threads. Bushing of stainless steel is optional.

YOKE BONNET, a single unit, has liberal space between yoke arms for easy access to packing box. Tongue and groove joint with body makes a pressure-tight seal with less tightening on the bolts, and eliminates possibility of blowing out the Teflon gasket.

GLAND consists of two pieces — gland flange and gland follower — to prevent binding of follower in case gland bolts are tightened unevenly. Crowned surface of flange secures tightness against gland without excessive tightening of gland nuts.

BODY Through-port design for full, free flow. Liberal seat height permits repeated refacing. Cast on body are directional arrow and bosses for drain connections. End flanges conform to M.S.S. specifications.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864

Sold Through Leading Distributors Everywhere

JENKINS BROS., 100 Park Avenue, New York 17, N. Y.

☐ Send the new stainless steel valve catalog

☐ Have a representative call on me

NAME & TITLE..

COMPANY..

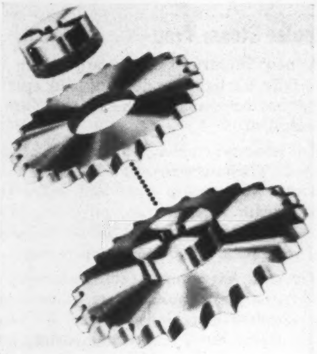
ADDRESS..

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Available literature or information may be secured by using convenient Reader Service Card on page 155

NEW EQUIPMENT



Stock Sprocket Service

Whitney Chain Co. has developed a unique finished bore stock sprocket assembly called Selecta Bore.

According to the firm, the sprockets provide a complete line of over six hundred possible pitch, teeth, and bore size combinations for better and faster service to customers, yet reduce the distributors' inventory items by two-thirds for the range of sprockets previously required.

The company says the new sprockets permit the distributor to fill his customers' finished bore sprocket requirements by assembling interchangeable plates and hubs. The combination thus available provides a complete line of finished bore sprockets with a minimum inventory of sprockets. Each assembled sprocket is ready for installation by the user, complete with standard keyway and setscrew. —K-1

Sheet Aluminum

A complete line of sheet aluminum architectural products, finished in an array of newly developed colors, has been announced by Aluminum Co. of America.

Offered on flat, patterned, corrugated, and ribbed sheet, the new colors are called Alumalure. The series includes shades of gold, blue, green, gray, brown, tan, yellow.

The new finish is of baked alkyd enamel. Five of the color tones are pigmented with aluminum to impart a high metallic luster. —K-2

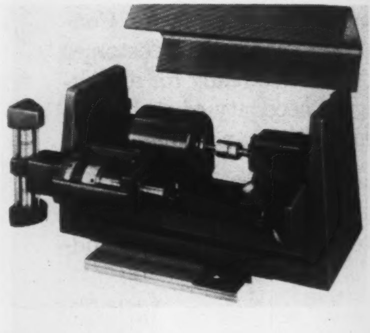
Heavy Duty Air Motors

A new line of Pistonair five cylinder, radial air motors for heavy-duty service has been announced by Joy Mfg. Co.

The units are said to combine extremely high starting torque and sustained load-lugging ability with a simple throttle valve control that allows instant starts and stops, unlimited reversibility and infinitely variable speeds. The firm says repeated overloads or stalls cannot harm the motors, and that they operate safely and dependably in explosive, damp, hot, or corrosive atmospheres.

Horsepower ratings range from $11^1/_2$ to 20 at 90 psi. Direct drive models turn at 400 to 800 rpm at rated hp with stall torques from 225 to 162 ft-lb. The models are available NEMA D flanged, making them interchangeable with electric motors having 254 UD and 256UD or 284UD and 286UD frame sizes; flanged with 15-in. diam bolt circle; and foot mounted. Weights are from 230 to 289 lb.

Geared drive foot mounted models give choice of five gear reduction ratios from 4.1:1 to 21.5:1. Output shaft rpm at rated hp ranges from 19 to 200 with stall torques of 4837 to 648 ft-lb. —K-3



Metering Pumps

Hills-McCanna announces its Masterline model metering pumps.

Each model is crowned by a streamlined, functional safety shield, thus offering a complete departure from the commonplace appearance of pumps, the company reports.

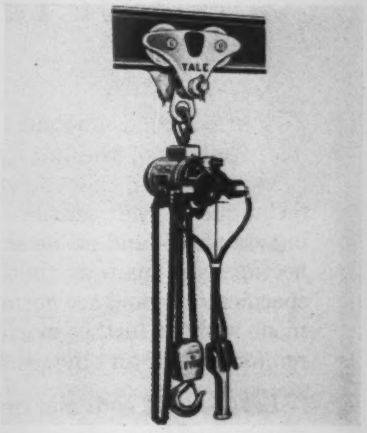
The pumps are powered by standard NEMA foot-mounted motors; speed reducers are kept separate from the motors. The drive mechanism has been improved, the firm states. Connecting rods extend 9 deg from axis of plunger to keep the eccentric load to a minimum. The check valve assembly features a straight-through flow. —K-4

Airless Spray Gun

Spraying Systems Co. has introduced its new 22 HPSSTC GunJet heavy duty spray gun for use in hydraulic spray coating and painting at pressures up to 2000 psi.

The new gun operates without the use of air, requiring only higher pressures as obtained in airless paint spraying systems, the firm reports. Orifice tips are interchangeable and are available in choice of capacities, spray angles, and materials.

Choice of tip materials include stainless steel, hardened stainless steel, chrome plated brass, and tungsten carbide inserts in chrome plated tip body. —K-5



Air Powered Hoists

Yale Materials Handling Div., The Yale & Towne Mg. Co. has introduced a line of air powered hoists.

The new line provides powered overhead handling equipment particularly applicable to installations where infinitely variable hoisting and lowering speed and extremely close load spotting control is essential, the firm reports.

The line is being introduced in link chain and roller chain models of 1000 and 2000 lb capacity. Both hook and trolley type hoists are available. The close load spotting and variable speeds of the new hoists are controlled by a choice of push button pendant or pull cable control.

Standard lifting speeds, utilizing 90 psi, range from 6 to 40 fpm in the 1000 lb model under full load and 3 to 20 fpm with the 2000 lb model with full load. —K-6

LENAPE Weld Ends & Rings

Save You Money!

Cost conscious designers and fabricators are taking advantage of the inherent economy of Lenape forged rings and weld end connections. Specialized production techniques permit seamless forging of most alloys, including stainless—and at lower cost than other methods. Connections and manway rings are manufactured to customer specifications, and are normally furnished ready for attachment without further machining or necessity of additional reinforcement, an obvious saving in time and labor.

Lenape weld ends and rings, such as those illustrated, are widely used for nuclear power reactors, high pressure steam generators, catapult accumulators and many other modern constructions.

Find out how Lenape can save you money on your pressure vessel connections. Write for information.

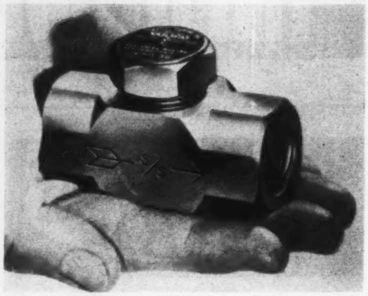
See our standard line of pressure vessel connections on pages 1128-1129 in the 1958 Chemical Engineering Catalog.

LENAPE
PRESSURE
VESSEL
CONNECTIONS

LENAPE HYDRAULIC PRESSING & FORGING CO.
DEPT. 114 WEST CHESTER, PA.
RED MAN PRODUCTS

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS



Impulse Steam Trap

A new impulse steam trap, engineered especially for light condensate load applications, has been announced, by the Yarnall-Waring Co.

The lever-type valve, which pivots about a fulcrum, discharges air and condensate at full capacity at start-up time and snaps shut when steam reaches trap, providing closer shut-off, the firm says. This action is also said to provide much quieter operation.

The trap has a replaceable valve-seat assembly, only one moving part, and stainless steel construction. It is designed for use on steam tracer lines, steam main drips, small platens, and other applications with light condensate loads. The trap is available in $^1/_2$ in. size only, for operating pressures 8 to 600 psig. **—K-7**

Overhead Cranes

Borg-Warner Industrial Cranes has introduced a series, N-TRMD, of overhead cranes designed for Class III industrial service with capacity range up to 20 tons and spans to 60 ft.

According to the firm, the series has been re-engineered with extensive use of standardized components and interchangeable parts. The units feature heavy duty hoist, heavy duty steel wheels on bridge and trolley, all welded jig bored and jig assembled end trucks, precision ball and roller bearings, large gusset plates at end trucks, outrigger machinery girder construction, heavy duty gear reduction bridge drive, fluid coupled bridge and trolley drives, full magnetic push button control, magnetic bridge brake. **—K-8**

Military Pumps

Tuthill Pump Co. announces Model CBGFK pumps designed to meet Air Force—Navy Aeronautical design standards for use on ground equipment.

The units are provided with a splined shaft, mounting pad, and porting to meet AN-D specifications. The new pumps are provided in two sizes, with capacities from 10 to 45 gpm at 150 psi and for speeds to 3600 rpm. **—K-9**

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Control Scriber

A new Leroy scriber that can be adjusted to form template characters of varying heights and slant angles without changing character width is available from Keuffel & Esser Co.

Given the catalog number 3237-12, the scriber can form characters either vertical or slanting at any angle up to 45 degrees forward, and any height from 60 to 150 per cent of the size of the figures represented on the drawing template used, the firm says.—**K-10**

Grease Testing Spindle

A precision high-temperature grease testing spindle has been developed by the research and development laboratories of Marlin-Rockwell Corp.

This spindle is capable of operation at temperatures up to 1000 F, with thrust loads up to 1000 lb or more.

A 204 size Conrad bearing is employed, and speeds up to 35,000 rpm can be used.—**K-11**

Regulator Pilot

Atlas Valve Co., announces the availability of a super-sensitive pressure regulator pilot which reduces and regulates the pressure of steam, air, gases, and liquids within fractions of 1 lb in one stage.

The firm says the Fig. 8000 pilot, which uses air or water pressure (20 to 75 psi) to actuate the control valve, can be used with single and double seat valves $^1/_2$ to 12 in. inclusive. It can be modified to provide for reverse action.

Applications suggested by the company include maintenance of constant reduced pressure in heating and service mains, vats, cookers, retorts, and press-platens. The valve can also be used to maintain a constant level in open tanks or as a pump governor where a constant delivery pressure is required, the firm states. —**K-12**

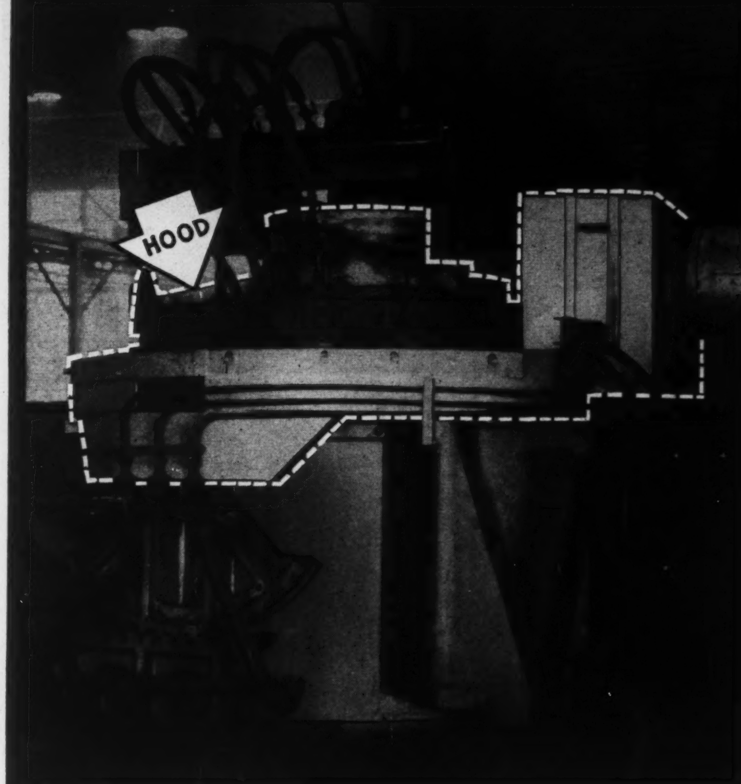
Stainless Gate Valve

A new line of split wedge stainless steel gate valves is announced by Jenkins Bros.

The valves are made of Types 316 and J-20 alloys suited to a wide range of corrosive conditions. They are fitted with a split wedge of ball-and-socket design which automatically adjusts to the tapered seating surfaces. According to the company, the disks, revolving freely in the wedge carrier, produce a self-cleaning action on the seat which reduces the possibility of galling and seizing.

The valve has a two-piece packing gland design said to eliminate binding of the follower when gland bolts are tightened unevenly. Chevron-type Teflon packing, body of through-port design, end flanges conforming to MSS SP-42 specifications, are other features. Size range of the 150 lb flanged end valve, Fig. 1327, is from $^1/_2$ to 8 in; of the 200 lb screwed end valve, Fig. 1326, from $^1/_2$ to 2 in. —**K-13**

CONTROL ELECTRIC FURNACE FUMES



Pangborn offers a new concept in electric furnace exhaust hoods!

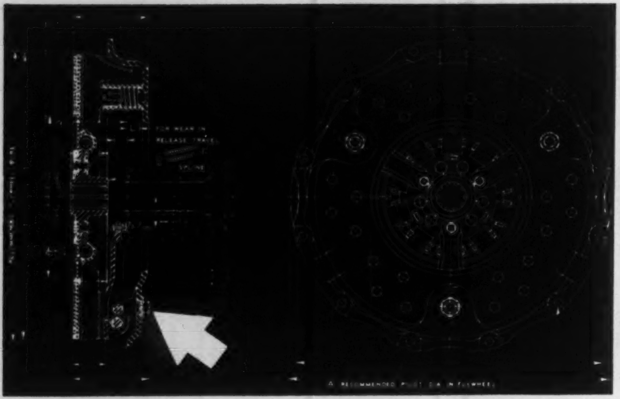
After years of development, Pangborn now offers effective control of smoke, fumes and dust from electric melting furnaces with minimum interference to furnace operations and maintenance. The hood design is based on the fundamental dust control principle of confining and capturing fumes and dust immediately adjacent the source. Effective control is secured with substantially reduced exhaust air volumes.

The Pangborn Exhaust Hood reduces the weight carried by the furnace roof; reduces hood areas subject to high temperatures; reduces electrode travel limitations and is applicable to top and side charge furnaces of all types and sizes.

With the exhaust hood connected to an efficient Pangborn Cloth Bag Collector, compliance with the most rigid air pollution control regulations is assured. For information call the Pangborn man in your area or write: PANGBORN CORP., 2200 Pangborn Blvd., Hagerstown, Md. *Manufacturers of Blast Cleaning and Dust Control Equipment.*

Pangborn CONTROLS DUST

ROCKFORD



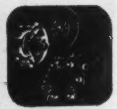
PATENTED

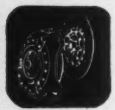
Patent No.
2818952

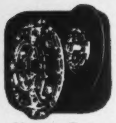
CLUTCH LEVERS

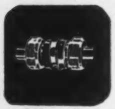
Reduce friction and wear • Improve clutch release action • and Prevent lever throw-out

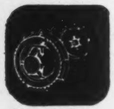
Patented rolling fulcrum pin action, in the release lever, results in much less friction and wear, and smoother release operation in this clutch than in some other types of clutches. Pin automatically returns to original position. Carefully balanced levers avoid lever throw-out at high speeds.

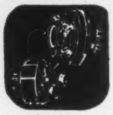

Small Spring Loaded

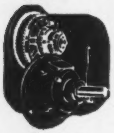

Automotive Spring Loaded


Heavy Duty Spring Loaded


Oil or Dry Multiple Disc


Heavy Duty Over Center


Light Over Center


Power Take-Offs

Speed Reducers

ROCKFORD
CLUTCHES
and
POWER
TAKE-OFFS

SEND FOR THIS HANDY BULLETIN
Shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS. Contains diagrams of unique applications. Furnishes capacity tables, dimensions and complete specifications.

ROCKFORD
B-W
BORG-WARNER

ROCKFORD Clutch Division BORG-WARNER
1307 Eighteenth Ave., Rockford, Ill., U.S.A.
Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

CLUTCHES

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Reed Vibrometer

Korfund Co., has announced the availability of its reed vibrometer, described as a light, compact, hand-held instrument of a high order of accuracy.

The company recommends the following applications of the unit: measuring vibration frequency and amplitude; determining the direction of maximum transmitted disturbances; locating the cause of unwanted noise due to resonant vibration; measuring the speeds of rotating equipment where shafts or rotors are not readily accessible by simply placing its probe against the machine housing; analyzing component frequencies of complex vibrations.

The output of the units built-in electromagnetic pickup can be attached to an oscilloscope or oscillograph by means of two binding posts on the meter, if it is desired to display or permanently record the vibratory phenomena being observed.

The instrument has a reed in the form of a steel strip whose effective length can be varied by means of a knob on the side. When the natural frequency of the reed coincides with that of disturbance being tested, the reed will vibrate strongly in resonance. The scale marker on the handle directly indicates the frequency. An amplitude comparator scale permits plotting of amplitude variations of the reed for different frequencies.

The vibrometer has a full frequency range from 120 to 15000 cpm. This is accomplished by using a weighted reed for frequencies between 120 and 600 cpm, and a free reed for frequencies between 600 and 15000 cpm. The firm says it is accurate to within 10 per cent at all frequencies with the weighted reed, and plus or minus 3 per cent with the free reed. For low frequencies, a calibration chart is provided. A scale marker on the handle indicates the frequency. **—K-14**

Mobile Cooling Units

Young Radiator Co. has announced development of specially designed, mobile cooling units.

The firm states the units are used to control temperature and to circulate hydraulic oils or electronic cooling fluids such as fluorochemicals. The capacity of one unit is 5000 w input (17,000 Btu/hr) and 10 gal of oil per min can be circulated against a maximum pressure at 250 psi. Other units are available with either water cooled or air cooled heat exchangers, the company reports.

The unit can be supplied with pumps having special Teflon seals for extremely low viscosity fluids. Casters are equipped with locks and the units will pass through a standard size door, the company states. **—K-15**

For Consulting Engineers Turn to Page 202

AEROJET...
for engineering careers

STRESS ANALYSTS

1. Experience and/or training in *analytical* stress computations, with emphasis on structural and pressure vessel applications. B.S. required; graduate work desirable.

2. Experience and/or training in *experimental* stress analysis. Familiarity with advanced experimental techniques and expedient methods of stress analysis. B.S. required; graduate work desirable.

GAS DYNAMICIST

M.S. or Ph.D. in engineering, physics or applied mechanics. Five to ten years' experience in analytical and experimental work in the fields of boundary layer studies, supersonic and hypersonic flows, or application of non-ideal-gas theories.

AERODYNAMICIST

M.S. or Ph.D. in aeronautical or mechanical engineering or applied mechanics. Five to ten years' experience in the field of advanced aerothermodynamics, missile aerodynamics, heat transfer in rockets, missiles, etc.

MISSILE SYSTEMS ANALYST

B.S., M.S. or Ph.D. in engineering, physics or applied mechanics. Five to ten years' experience in analysis and evaluation of interactions between propellant systems and other missile components. Capable of developing optimum vehicle configurations from the standpoint of the propulsion system.

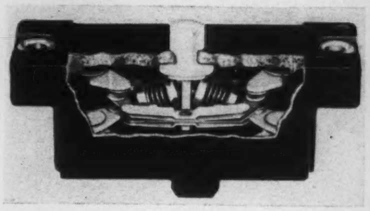
U.S. Citizenship Required

Resumes cordially invited. Write:

E. P. JAMES
AEROJET-GENERAL CORPORATION
P.O. BOX 1947
SACRAMENTO, CALIFORNIA

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS



Limit Switches

A new line of precision limit switches, designed for industrial applications where millions of operations are required, has been described in a booklet, EA-154, by Cutler-Hammer Inc.

The switches incorporate a movable contact assembly utilizing two compressed coil springs to provide a quick make and break action. A leaf spring, carrying the contacts, is designed to assure adequate contact pressure at all times; eliminate points of zero contact pressure and provide a nonteasing action even with an extremely slow operating motion.

The contact carrier spring affords sufficient contact wipe to assure good electrical contact on low voltage, the firm reports. The unit is completely enclosed in a semi-dust tight molded phenolic case of great physical strength and high arc resisting capacity. The switch has an electrical rating of 600 v. **—K-16**

Pressure Transmitter

Yarnall-Waring Co., announces a differential pressure transmitter for controlling a distant indicator, controllor, or other electrically-operated receiving instrument.

The instrument consists of a diaphragm mechanism in a pressure housing with pressure connections at the bottom, and a sensing coil which operates the remote receiver. The sensing coil is protected by a weatherproof cover. Cable connection to receiver is at right end of this cover.

The unit is connected to the liquid vessel, fluid line, or other container by two tubes. At the transmitter, the tube connections lead to opposite sides of the diaphragm. Variation in the differential pressure on diaphragm causes change in output of sensing coil which is transmitted to the remote receiver.**—K-17**

Ductile Iron Pipe

American Cast Iron Pipe Co. has announced introduction of a complete line of pipe, tubing, casing, fittings, and special castings made from ductile iron.

The firm says a major application of the pipe is in underground gas and water service mains where high pressures, extreme beam and crushing loads, unusual shocks and stresses, unstable bedding and deep fills may be encountered. Under such adverse conditions, the iron pipe will actualy twist and bend without breaking, the company states. A variety of joints are available. **—K-18**

MICROTOMIC
FIRED AT
2000° F

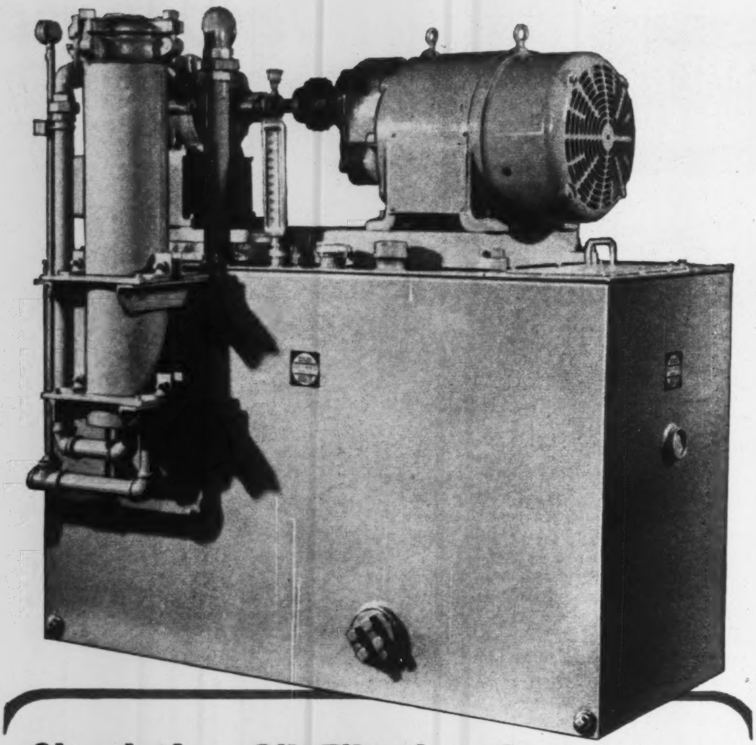
EBERHARD FABER
2H
MICROTOMIC
U.S.A.

Trademarks Reg. U.S. Pat. Off.

Intense heat is important in the making of pencil lead. Under the supervision of Eberhard Faber pencil engineers, Microtomic leads are fired up to 2,000 degrees Fahrenheit in scientifically-controlled ovens. One more reason why Microtomic holds a finer point longer... produces rich, black lines... and is the natural choice of professionals. Bull's eye identifies each of 18 uniform degrees.

MICROTOMIC
Proves its Point Every Time

110th Anniversary, 1849-1959
EBERHARD FABER
WILKES-BARRE, PA. • NEW YORK • TORONTO, CANADA



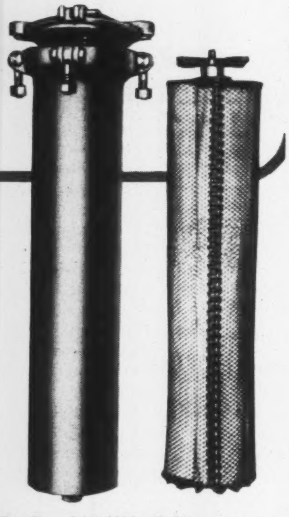
Circulating Oil Filtering System uses

NUGENT FILTER

A number of these compact units are now in operation in the Southeastern plant of a leading producer of synthetic fibers. A Nugent Fig. 1116HA-4L filter is the workhorse of each system which filters and circulates 300 SSU viscosity lubricating oil at the rate of 35 GPM.

The complete units were built by Louis H. Hein Co., Ardmore, Pa. They can be adapted for use with hydraulic oil, coolant, quenching oil, various chemicals and other liquids.

If you have a filtering problem, Nugent engineers will be pleased to work with you toward a speedy, economical solution. Just send an outline of your requirements.



This Fig. 1116HA-4L filter is just one of many sizes and types offered by Nugent. Single and duplex models are available.

ESTABLISHED 1897
NUGENT TRADE MARK

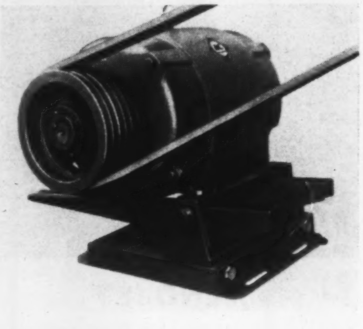
WM. W. NUGENT & CO., INC.
3412 CLEVELAND STREET, SKOKIE, ILLINOIS

REPRESENTATIVES IN PRINCIPAL CITIES

OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS



Tilting Motor Base

A new reaction torque tilting motor base for automatic belted drive tension control under changing load conditions has been announced by Allis-Chalmers.

Available in bases to accomodate all NEMA sizes through frame 505 as well as for special applications requiring larger frames, the new reaction torque motor base makes possible more efficient use of space because of its compact design, the firm reports.

It is engineered on the principle that action and reaction are equal but opposite. The motor base's reactive torque is directly proportional to the horsepower. The belt tension increases and decreases as the load varies.
—K-19

Explosion Proof Thermostat

A new explosion proof thermostat, UL approved for Class 1, Group D hazardous areas, has been announced by Fenwal Inc.

Designed for convenient immersion in tanks, wall installation, and for exposure to contaminated environments, the unit is made up of three sub-assemblies: a Series 47000 Thermoswitch unit, stainless steel well, and an explosion proof junction box that completely protects the lead wire outlets.

The firm says the unit is completely adjustable over a 32 to 500 F range, and can be exposed indefinitely to −100 F, or, for short periods, to 100 F above its set point. Current rating is 10 amp 115 vac, or 5 amp 230 vac.
—K-20

Submersible Pump

A new, low-priced submersible pump is being marketed by Deming Co.

The new submersible, Fig. 6700-3ALCA, is powered by a $^{1}/_{3}$ hp motor with capacities up to 800 gph. The units have flatted stainless steel shafts of extra-large diameter, claimed to give eight times the driving force of the ordinary key-type shaft.

Diffusers are made of Fianite, a recent development of the company, which is described as a thermosetting material that won't rust or corrode and resists abrasion.
—K-21

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Vacuum Air-Cooled Pump

A newly designed Model 106 high vacuum pump unit with six sets of dual vanes, positive high-pressure oil seal and a patented radiator oil-cooling system, is announced by Leiman Bros.

According to the company, the pump provides a steady vacuum of 29.9 in. Hg in continuous operation, at an average temperature of 200 F and has a capacity of 50 to 105 cfm. The over-all unit dimensions are 47 in. long, 36 in. high and 26 in. wide.

The balanced rotor is divided into six slots, each equipped with two independent steel vane sections, separated by a high pressure oil film which is forced outward between the vanes to the cylinder wall during rotation. This is designed to assure a constant oil seal between the dual vanes and positive lubrication of the cylinder wall. The vanes provide two contact surfaces on the cylinder wall to seal off the low and high pressure side of the pump. The firm says that use of six dual vanes divides the high-pressure air pulsations into many small pulsations, resulting in a more even flow of air, less vibration and a less bulky foundation.

The pump is cooled by a radiator-cooled lubricating system, in which oil is constantly recirculated and cooled for passage through the pump. This system, the company claims, eliminates water-cooling, piping, leakage problems and the necessity of placing the pump near an available water supply. The lower-temperature operation permits speeds up to 800 rpm, maintains oil viscosity for maximum lubricating properties, prevents carbonization of oil, the firm states. **—K-22**

Hose Assembly Machine

A new power machine for speeding up assembly of reusable Hoze-lok fittings onto industrial rubber or cotton covered, wire or fabric braided hose is announced by Parker Fittings & Hose Div., Parker-Hannifin Corp.

It is designated Model 422. The unit is portable, weighing approximately 160 lb and is driven by a $^{1}/_{2}$ hp, 60 cycle electric motor. The company says the unit can readily handle hose ranging in size from $^{1}/_{4}$ through 1-$^{3}/_{8}$ in. ID. **—K-23**

Forged Steel Fitting

Bonney Forge & Tool Wks., has announced its Sweepolet, a forged, integrally reinforced, insert butt welding pipe fitting specially designed for applications on high yield pipe in the oil and gas transmission industries.

According to the company, the fittings assure maximum efficiency of metal placement with minimum weld; optimum distribution of stresses due to both internal pressure and externally imposed loads. They take less time to install and cost less than any other fitting, the firm claims. **—K-24**

When the Job Calls for Bellows, Assemblies Cost You Less!

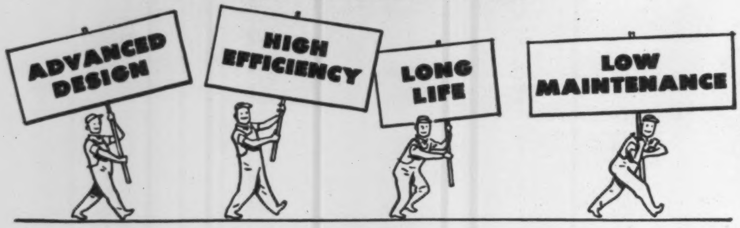
Engineered to *your* design requirements, Fulton Sylphon® bellows assemblies save you time and headaches . . . and reduce production costs! Eliminate costly, tedious assembling of components—and necessary in-plant testing—by specifying *complete* Fulton Sylphon assemblies. One-source manufacturing responsibility, more economical purchasing . . . and every assembly is pilot-tested before it leaves the plant!

For suggestions on how bellows assemblies could fit into your product picture—write for Catalog EK-1400.

Mr. Controls

Robertshaw-Fulton
CONTROLS COMPANY
FULTON SYLPHON DIVISION
Knoxville 1, Tennessee

Dust Collection Performance is what you buy from Norblo



We haven't introduced a "new model" for many years!

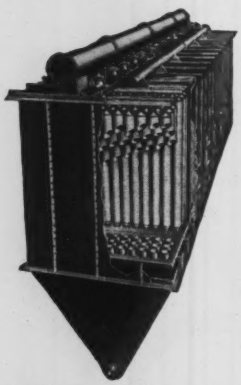
Yet Norblo Dust and Fume Collectors are completely modern—up to date. We keep them that way. And we've found it isn't the *model* that interests users . . . it's the *performance* of the equipment we recommend.

Outwardly, Norblo Equipment of several types *appears* to be just about the same as it was a quarter century ago. (There isn't a need to "stylize" these facilities.) But Norblo engineering — mechanical elements — materials and special components — all undergo constant scrutiny and testing. When improvement possibilities are discovered they are adopted at once — no waiting for next year's model!

Norblo engineers study to improve efficiency, add to equipment life, and reduce maintenance trouble and expense. Our repair parts business is terrible! (Low, that is!)

For 45 years Norblo Equipment has supplied outstanding dust arresting and recovery service for the rock products, smelting, chemical, metal working, milling and processing industries. Norblo engineers the complete installation with ample capacity for your needs, with wide adjustability and all the safeguards you may need.

If you have a dust or fume problem, consult Norblo. Write for Bulletin 164 and information form.



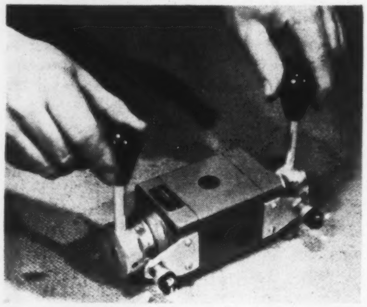
The Northern Blower Co.
6421 Barberton Ave. • Cleveland 2, Ohio
Telephone OLympic 1-1300

Norblo engineers and manufactures dust collection equipment in Bag Type, Hydraulic and Centrifugal Systems. High recovery at low operating and maintenance costs is assured, with guaranteed performance. Norblo Portable Bag Type Units are convenient for localized or intermittent dust control.

Norblo ENGINEERED DUST COLLECTION SYSTEMS FOR ALL INDUSTRIES

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS



Double Hydraulic Valve

A double hydraulic valve is being introduced by the Clark Engrg. & Mfg. Co.

The firm states the new valve is available in three-way and four-way combinations. Sizes range from 2 to 40 gpm with detented or spring return handles. Cem-lap seals mating with optically flat rotor surfaces are designed to assure positive sealing at 2500 psi pressure for oil and 2000 psi for water and gas.

According to the company, the roller thrust bearings assure smooth action and low handle pressures. Motor starting switches can be added as shown for a-c or d-c operation. The pump then runs only when the handle is turned.

The new double valves, the firm said, are suitable for use in fork lifts and other materials handling equipment, in loaders, dozers and other road machinery, and in machine tool applications. **—K–25**

Servo Motors

Electro Products Div., Western Gear Corp., announces the design and manufacture of Size 10 and 11 servo motors.

The motors are available for 26, 55, or 115 v a-c 400 cycle operation. They are 6-pole units having a stall torque of .6 oz- in. minimum and a no load speed of 6500 rpm with rotor inertia Igm cm^2.

The acceleration at stall is 42,000 radians/sec^2. They are designed to operate in ambient temperatures from −65 to +125 C. They measure $1^{11}/_{32}$ in. in length. **—K–26**

Whiteprint Machine

A new compact whiteprint machine designed to produce sharp, evenly-developed copies for offices, engineering departments and for supplementary use in high volume print rooms has been introduced by the Reproduction Products Co., Subsidiary of Ozalid Div., General Aniline and Film Corp.

The Reprofax Viking has an 18-in. printing width, said to be ample for processing two letters side-by-side or for reproducing 18-in. wide drawings of any length. It has printing speeds up to 18 ft per min, and can make as many as 450 letter-size copies per hour, the firm reports. **—K–27**

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Cleaning System

Complete ultrasonic cleaning systems in matched counter-height cabinets are now available from Branson Ultrasonic Corp.

The Series C cabinets, welded of 16-gage Type 316L stainless steel to uniform dimensions, 26 × 24 × 32 in. high, house the firm's Sonogen generator, the cleaning tank, filter, rinse tank, and dryer.

The company says many different combinations and arrangements are possible, depending on individual needs of the user. A standard installation consists of three basic units: generator, tank, and filter. To these, rinse tanks and dryer may be added.

R-F output of the ultrasonic generator at 40 kc is 500 w average, 2000 w peak on pulses. Power input is 1.5 kw, 115 v a-c, 50 to 60 cycles, or 220 v single-phase a-c. Generator is forced air-cooled, has a circuit breaker with indicating light, and a line voltage control with meter.

The cleaning tank is connected electrically to the generator, so that the ceramic transducers against the tank bottom transmit ultrasonic power into the cleaning solution. Two plumbing connections provide inlet and drain for the solution, which is constantly recirculated to the filter.

The stainless steel recirculating filter has a removable cartridge, with a 3 to 5 μ retention, 1 μ available. A 6-kw strip heater is part of this unit, thermostatically controlled to keep the cleaning medium at the desired temperature.

Either spray or immersion rinsing is possible in the rinse tank. A retractable hose and a manual valve for connecting the tank to the shop air system are also provided. **—K-28**

Adjustable Couplings

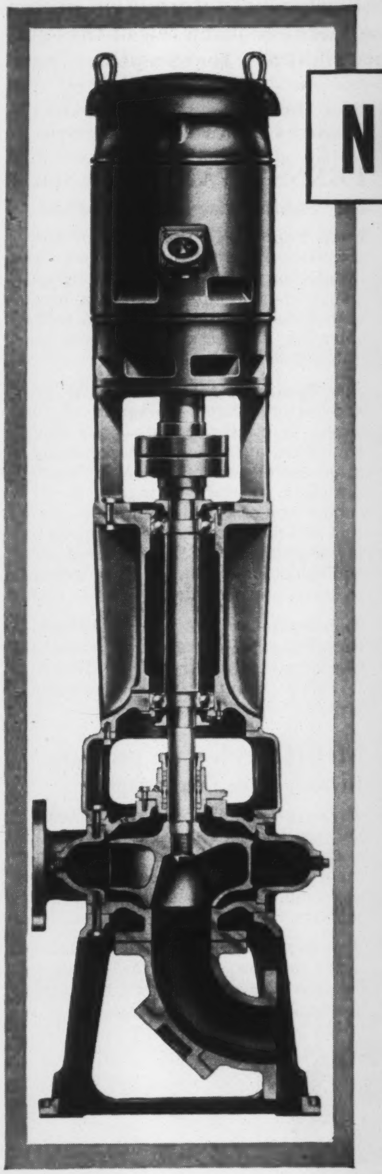
PIC Design Corp., Subsidiary of Benrus Watch Co., is offering a new line of adjustable couplings.

The units are called Type T-9 and T-10, zero adjustable couplings, specifically designed to provide precision rotational angular adjustment between two synchro rotors or other mechanisms requiring angular displacement.

The firm says the new type coupling eliminates the need for rotating a synchro in its mounting to zero-in with its companion synchro. Desired angular displacement between the two synchros is obtained instead by rotating one synchro rotor in respect to the other through the medium of this new adjustable coupling.

Precision angular adjustment is possible since one turn of the coupling adjusting screw rotates one coupled shaft in respect to the other through only 12 deg, the company reports. A continuous rotational adjustment through 360 deg, in either direction, is another feature of the coupling. **—K-29**

For higher pumping efficiency of solids in suspension!



NEW

Fairbanks-Morse

5440A Non-Clog Pumps

Ideal for pumping unscreened liquids with large solids in suspension

- industrial wastes
- sanitary sewage disposal
- industrial processes

Here is your answer to higher efficiencies wherever you are pumping solids in suspension!

All-new Fairbanks-Morse 5440A Non-Clog Pumps feature quick, easy convertibility between any of the many vertical and horizontal types. Power requirements of the pump are always perfectly matched to the electrical and mechanical components. Precision-machined centering fits assure accurate alignment. Exclusive F-M bladeless impeller design minimizes maintenance by preventing clogging from solids and stringy material. The 5440A is only one of many F-M solids-handling pumps designed to meet a broad range of requirements. For information, write Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.

Ask for new 5440A BULLETIN!

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

ELECTRIC MOTORS · DIESEL, DUAL FUEL AND GAS ENGINES · PUMPS
COMPRESSORS · GENERATORS · MAGNETOS · HOME WATER SYSTEMS

Burroughs

ANOTHER NEW ROSTER OF OPPORTUNITIES APLENTY AT BURROUGHS

Again we are stepping up our aggressive research and development programs. These have already made us a $300-million-a-year force in *advanced electronic and electro-mechanical information processing* for both commerce and defense. Here are just a few of the many exceptional career opportunities open right now for exceptional men:

CALIFORNIA at our ElectroData Division in Pasadena

Electronic Engineers with experience in areas such as logical design, computer components, circuit design, electronic packaging, sub-miniaturization, manufacturing costs and processes.

Electronic Data Processing Specialists with experience in areas such as applied programming, applied mathematics and technical sales consultation, etc.

For Details, write Mr. C. J. Blades, Manager, Professional Employment, Dept. 208A, Burroughs Corporation ElectroData Division, 460 Sierra Madre Villa, Pasadena, California.

PENNSYLVANIA at our Research Center near Philadelphia

Systems Engineers with specific experience in systems analysis and design of digital data processors. Should be trained in engineering, physics or mathematics. Graduate training desirable.

Mathematicians, computer-oriented, with particular experience in problem formulation, numerical analysis, and applied mathematics—in connection with formulation and design of computational procedures. Procedures involved in problems of guidance and air defense, trajectory calculations, logical design, sampled data systems, circuit analysis and more. Advanced degree in mathematics preferred.

For Details, write Mr. James Gilroy, Professional Placement Coordinator, Dept. 208B, Burroughs Corporation Research Center, Paoli, Pennsylvania.

PENNSYLVANIA at our Military Field Service Division in Phila.

Field Engineers responsible for the direction of several field teams in installation and maintenance of digital computers and integrated data processing systems. Required BSEE, with extensive field service experience in military electronic equipment.

Site Engineers to attend formal lab and lecture training program of 16 weeks in electronic data processing equipment at full salary. Assignments after completion of formal program plus field training will involve direct supervision of a field team in installation and maintenance of data processing equipment. BSEE preferred, or equivalent experience. Must be willing to travel and relocate.

For Details write Mr. A. J. Bellace, Employment Supervisor, Burroughs Corporation Military Field Service Division, Dept. 208C, Burroughs Drive, Radnor, Pennsylvania.

MICHIGAN at our Burroughs Division in the Detroit Area

Experienced Electronic, electrical and mechanical engineers to work in many areas of research and development for information processing equipment applicable to commercial and military use.

For Details, write Mr. A. L. Suzio, Administrator, Corporate Placement Services, Dept. 208, Burroughs Corporation, Detroit 32, Michigan.

Burroughs

Burroughs Corporation

"NEW DIMENSIONS / IN ELECTRONICS AND DATA PROCESSING SYSTEMS"

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Sprayed Coil Dehumidifier

A line of low pressure and high pressure blow-through sprayed coil dehumidifiers is now available from American-Standard, Industrial Div.

The new models are designed to meet requirements of medium and high velocity all-air systems in multi-story buildings. Both low and high pressure units are available in 127 sizes with capacities from 2310 to 45900 cfm and for operation to 9-in. wg static pressure.

The heavy-duty units feature a casing designed to provide a unit that is air and water tight when used in single zone, multizone or dual duct blow-through systems. They are available with either direct expansion Type X coils or chilled water Type W coils. The firm states that both ends of the cooling coils are sealed inside the casing to eliminate sweating and dripping due to condensation. The sprayed coil dehumidifiers are designed to permit removal of the coil units for maintenance or service.

A separate section fastened to the air entering end of the dehumidifier contains inlet louvers having removable blades. On dual duct or multizone systems, the louvers prevent spray from backlashing when the system air is passing through the bypass duct or hot deck above the sprayed coil dehumidifier. **—K-30**

Vertical Mounting Gearmotors

Lima Electric Motor Co. has announced the addition of vertical gearmotors to its line of electric motors and speed reducers.

The new units are available with either flanged mounting face, or with standard vertical extended housing. They are supplied in double or triple reduction units with Duti-rated lifetime gearing, in ratings from 1 to 75 hp, with reductions from 350 to 7$^1/_2$ rpm.

Built with standard Lima motors in drip-proof, totally enclosed fan-cooled or explosion proof enclosures, these units operate at normal torque, on 3 or 2 phase, 60 cycle, 208, 220/440 or 550 volts. Special voltages and frequencies as well as mechanical modifications are also available. **—K-31**

Flexible Tubing Insulation

Owens-Corning Fiberglas Corp., has announced availability of a new flexible tubing insulation made of a foamed plastic material and designed for installation on liquid cooling and heating lines to prevent condensation.

The product is expected to be used primarily on short run-out lines to air conditioning equipment in hotels and other commercial buildings. The insulation is supplied in one piece for slipping over tubing or, for existing pipe runs, the sections can be longitudinally slit with a knife, snapped on the pipe, and sealed with the firm's 500 adhesive.

Sections are 6 ft in length and the material is available in wall thicknesses of $^3/_8$, $^1/_2$ and $^3/_4$-in. Sizes are $^3/_8$-in. ID to 3 in. **—K-32**

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Thyratron Control Device

A new device for control of solid state thyratrons has been developed by Control Div. Magnetics, Inc.

It is called the Control Amplifier, and is designed to provide the necessary signal to control solid state thyratron systems which, in turn, can drive inductive loads as well as resistive loads without complicated circuitry.

According to the company, the unit, when combined with solid state thyratrons, provides circuit designers with a complete solid state system from logic input to power-handling output. The firm says it substantially reduces the amount of component equipment required to control solid state thyratrons in proportioning applications, where phase-adjustable control pulses are required.

Circuits for the amplifier may be used for static switching, temperature control, automatic welding control, variable d-c supply, constant current supply, pulse width modulation, and similar applications. **—K-33**

Hydraulic Valves

Rivett Inc., has introduced a new line of 3000 psi hydraulic valves meeting all JIC requirements.

It is designated Model 6100. The valve is sub-plate mounted and manually controlled by lever. It is available in five actions: moved manually to either end position; moved manually to IN position and spring-offset to OUT position; moved manually to OUT position and spring-offset to IN position; spring centered; ball detent where valve piston is held in either end position by detent.

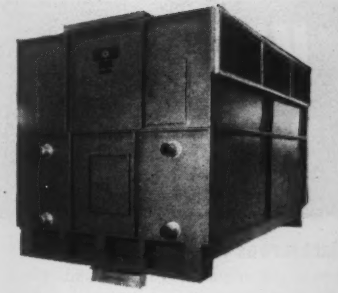
It is available in seven basic spool designs and in sizes from $1/4$ to 2 in. Write for catalog section 210 mentioning this magazine. **—K-34**

give!
...because they need the money

for DISASTERS • ARMED FORCES
BLOOD BANK • TRAINING PROGRAMS

This Self-Contained Fluid Cooling System

. . . gives most accurate temperature control



Applied in cooling industrial machines or processes to temperatures approaching the ambient wet-bulb, the NIAGARA *Aero* HEAT EXCHANGER is independent of any more than a nominal water supply or disposal. The coolant system is a closed one, free from dirt and maintenance troubles.

Heat is removed from your process *at the rate of input,* giving you precisely the temperature you require and assuring the quality of your product. Heat may be added to prevent freezing in winter or for better control in a warm-up period. Liquids or gases are cooled with equal effectiveness.

Heat is rejected outdoors. Only the little water evaporated on the cooling coils in the air stream, or discharged to prevent hardness build-up, is consumed.

Niagara sectional construction saves you much installation and upkeep expense, gives full access to all interior parts and piping. Your equipment always gives you full capacity and "new plant" efficiency.

Write for Niagara Bulletin No. 132 for complete information

NIAGARA BLOWER COMPANY
Dept. ME-3, 405 Lexington Ave., New York 17, N.Y.
District Engineers in Principal Cities of U. S. and Canada

How to silence 38 stories of piping

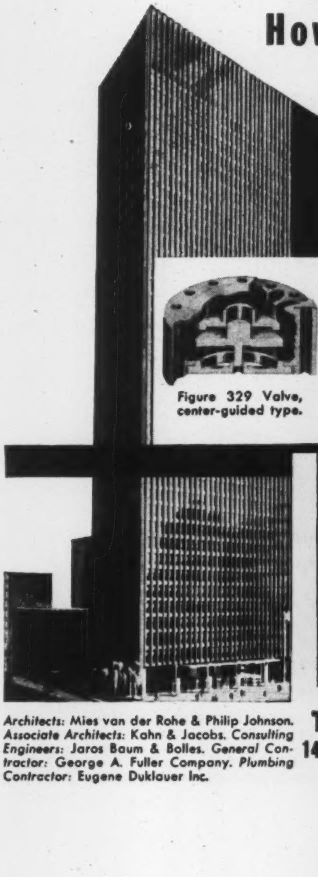


Figure 329 Valve, center-guided type.

In the new Seagram Building in New York, Williams-Hager Silent Check Valves control water hammer. They silence and protect piping by operating instantly when flow reversal starts or when flow is zero. Just one of hundreds of outstanding buildings protected by Williams-Hager Valves.

Write for Bulletins
—No. 654 on Valves, No. 851 on Cause, Effect and Control of Water Hammer

WILLIAMS • HAGER
Silent
CHECK VALVES

Architects: Mies van der Rohe & Philip Johnson. Associate Architects: Kahn & Jacobs. Consulting Engineers: Jaros Baum & Bolles. General Contractor: George A. Fuller Company. Plumbing Contractor: Eugene Duklauer Inc.

THE WILLIAMS GAUGE CO., Inc.
149 Stanwix St. • 2 Gateway Center • Pittsburgh 22, Pa.
Our 73rd Year • 1886-1959

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Instantaneous Heaters

A new, pre-engineered, fully standardized line of Ross instantaneous heaters has been introduced by American-Standard, Industrial Div.

The firm says the new units have an exclusive, extra-large steam entrance area beyond the tube bundle, that prevents tube damage by impingement and prolongs tube life. Standard construction consists of steel shells, cast iron bonnets, and seamless copper alloy U-tubes. They are designated Type W-100. The units have removable, pull-thru tube bundles.

They are available in 128 sizes with two and four pass arrangements, nominal tube lengths up to 10 ft and shell diameters through 20 in. **—K-35**

Pressure Plugs

What are described as the first commercially available flush-seating pressure plugs are offered by Standard Pressed Steel Co.

When installed in hydraulic, pneumatic, or other fluid pressure systems, the new hex socket plugs seat virtually level with the material into which they are threaded, the company states.

The unit is called Unbrako LevL-Seal and is claimed to be unique in that it has a different taper from that of the tapped hole. This feature is said to provide a positive leakproof seal without compound even under high fluid pressure.

Secret of the plug is in the interference fit, resulting from a deliberate interference in taper between the plug and tapped hole. The company says this permits closer control over point of seating of the plug. Designed for use in standard $^{3}/_{4}$-in-ft taper tapped holes, the plug has a carefully controlled taper of $^{7}/_{8}$ in-ft.

Additional control is obtained by an improved method of production gaging. All gage measurements are made from the top end, whereas conventional plugs are gaged from the point end, the firm states.

The new unit is designed to seat flush within half a pitch (or turn of thread). By comparison, the company says, conventional plugs protrude three, four, or more full turns. **—K-36**

Automatic Filter

American Air Filter Co. announces its Type B Rollotron, a new design agglomerator-filter.

The new unit is claimed to combine the high efficiency of an electronic precipitator with the low maintenance of an automatic, renewable media filter.

In the Rollotron, dry, electrostatically charged plates are used to agglomerate such atmospheric contaminates as dirt, bacteria, pollen, smoke. The agglomerated particles (including submicron sizes) are held together by intermolecular attraction until they are picked up by the air stream and deposited in the renewable media of the storage section. There the accumulated dirt is automatically wound into a compact roll for easy disposal.

The firm states resistance to air flow is uniform and constant and filter performance is always at optimum level regardless of job conditions. **—K-37**

AMERICAN
PRECISION BORED & HONED PARTS
TO SPECIFICATIONS

American has produced hundreds of power cylinders to most exacting specifications. Our deep boring and honing techniques have kept pace with the precision internal surfaces needed in the application of air and hydraulic cylinders. Whatever the basic material required, we have the tooling equipment and know-how to produce cylinders up to 16 inches I.D. and to 40 feet lengths.

We are equipped to supply American cylinders bored, honed, flanged, padded and externally machined to your specifications.

AMERICAN HOLLOW BORING CO.

You can depend on American as a reliable source for precision bored and honed parts for your most exacting applications.

1058 West 20th Street • ERIE, PENNA.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Time Delay Relay

Cramer Controls Corp. announces its Type 471 time delay relay designed to provide an accurate, adjustable time delay between the operation of a control circuit and the subsequent transfer of one or two load switches.

The firm says that through selection of external wiring connections, the unit offers broad application flexibility and excellent accuracy at moderate cost. Uses include control of machine tools, batch processes, heat treating, automatic mixers, electronic devices and signalling equipment.

Time ranges from 15 sec to 24 hr. Adjustment range from about 10 to 100 per cent of full scale. Repeat accuracy is within 2 per cent reset time approximately 1/2 sec, the company reports. Switch ratings are 10 amp 125 v or 5 amp 250 a-c resistive load. Motor and clutch ratings are 115 and 220 v, 25, 50, and 60 cycles. Direct clutch is standard; reverse clutch, optional. **—K-38**

General Purpose Valve

Stockham Valves & Fittings has announced the availability of a new nonlubricated general purpose valve with two Teflon O-rings in the face of the plug.

It is called the Wedgeplug O-Seal, and is designed to double-block and bleed effectively in most services, doing the job of two ordinary valves or a line blind.

Other advantages of the new valve include protected seats, double seating for double safety, and the assurance of no product contamination.

Because of the double pressure-sealing effect of the O-rings, the upstream as well as the downstream seats hold bubble-tight against line pressure, the company reports. **—K-39**

BUSINESS NOTES

Hydraulic Firm Acquired

Purchase of S. Morgan Smith Co. by Allis-Chalmers has been announced. The York, Pa. firm and its subsidiaries will operate as A-C's newly created Hydraulic Div. within the Industries Group.

As the Hydraulic Div., fifth area within the Industries Group, the York facilities will be devoted to the continued research, design, engineering, and fabrication of a complete line of hydraulic turbines and accessories, pumps and pump-turbines, valves for industrial, waterworks and power applications and specialized heavy hydraulic equipment.

New Field Representative

Orr & Sembower, Inc. manufacturer of packaged automatic boilers, fuel burning systems and other heat exchange and combustion equipment, has announced the appointment of Bagwell Co., 1740 East 6th St., Tulsa, as its sales and service representative in the state of Oklahoma.

Planetary Gear License

De Laval Steam Turbine Co., announces an exclusive license agreement with Mr. W. G. Stoeckicht of Munich, Germany, under which De Laval will manufacture and sell planetary gears in the United States, to be known as De Laval Stoeckicht Gears.

For BIG performance . . .

The BIG change is in ALL NEW

G. I. FANS

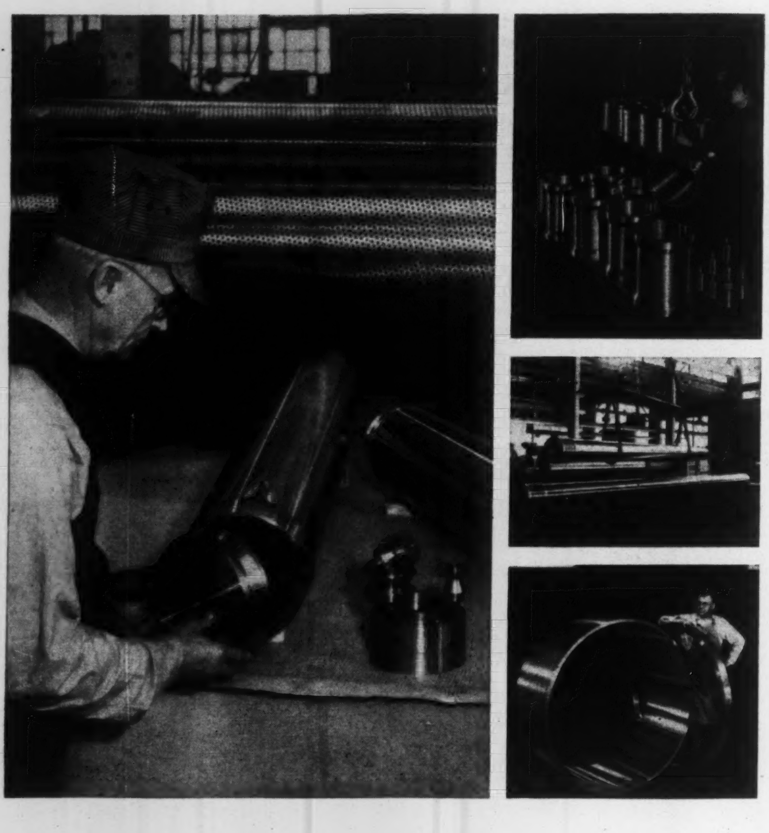
...featuring flat radial blade wheels

Workhorse durability plus precision machine efficiency equals BIG performance. All new G. I. Fans incorporate advanced aerodynamic techniques that combine improved efficiency with all the advantages of the flat radial blade design. Three wheel types are offered to provide rugged performance for virtually any type application.

Write for details in Bulletins 585, 586.

THE NEW YORK BLOWER COMPANY

Sales Offices: 3161 S. Shields Avenue • Chicago 16



Your parts ***last*** *longer when they're*

SHENANGO CENTRIFUGAL CASTINGS

Your machine parts, ferrous or non-ferrous, are subject to stress, strain and friction, day after day, year after year . . . so specify Shenango . . . and see what a difference this makes!

Shenango's centrifugal casting process insures longer life because of finer, more uniform, *pressure-dense* grain to begin with . . . free of inclusions, porosity, blowholes and other weakening defects. Then, far less machining is needed and your part is stronger . . . to last and last *and last!*

Shenango's modern and fully-equipped shops will supply you with ferrous or non-ferrous symmetrical parts in virtually any shape or size . . . rough, semi-machined or precision-finished to your most exacting specifications. For full details, write: *Centrifugally Cast Products Division,* The Shenango Furnace Company, Dover, Ohio.

SHENANGO CENTRIFUGAL CASTINGS

COPPER, TIN, LEAD, ZINC BRONZES • ALUMINUM AND MANGANESE BRONZES
MONEL METAL • NI-RESIST • MEEHANITE METAL • ALLOY IRONS

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Chain Distributor

J. W. Mender Chain & Gear Co. has been appointed industrial distributor to handle all products of Acme Chain Corp. on the West Coast. A complete stock of roller chains and accessories will be stocked and distributed from the firm's Portland branch and its warehouse at 6011 S. Central Ave., Los Angeles.

Manufacturer's Reps

Chicago Molded Products Corp. has appointed three new manufacturer's representatives. Stetler and Stetler, Buffalo, N. Y. will handle the Campco (plastic sheeting) and custom molding divisions in the state of New York, excluding New York City.

Art Sawyer and Associates, Detroit, Mich., will service the three major auto companies and subsidiaries with Campco and Custom Molding Products. John Webb, Southern Dynamics, Inc., Orlando, Fla. will cover Alabama, Georgia and Florida.

Research Center Planned

Lockheed Aircraft Corp., California Div. announces purchase of a 198-acre site near Saugus, Calif., for a multimillion dollar advance scientific research center to explore problems of flight up to 10 times the speed of sound and at altitudes where man has never flown.

Resulting from three years of planning study, the new facility will be known as Lockheed Research Center. The center will be financed entirely with company funds. First step will be the construction early in 1959 of a $5,000,000 supersonic wind tunnel and high-altitude environmental test facilities capable of subjecting complete aircraft to simulated conditions of flight up to 150,000 feet above the earth.

LATEST CATALOGS

Valve Catalog

The firm's line of valves is described in an illustrated 20-page catalog, 59–60, issued by Barksdale Valves.

The catalog is divided into three sections according to the type of medium used: oil, water, or air, and features manual, foot-operated, and solenoid valves. Under manual and foot-operated valves are listed the 4-way, shut-off, manipulator, and dual pressure valves. Solenoid valves are designed for most common a-c and d-c voltages and come in standard or explosion-proof housings. Illustrated are the solenoid operated 4-way, 3-way, shut-off, and diverter valve series.

—K–40

Need more engineering information on products featured in this issue?

USE THE POSTAGE-FREE CARDS . . .

If you would enjoy receiving additional engineering information on any of the products

advertised in this issue or
detailed in the Keep Informed Section

. . . . circle the page numbers of these advertisements or items on one of the cards below . . . . fill in your name and mail to us. Your requests will be promptly forwarded. All information will be directed to you.

(Note: Students please write direct to manufacturer.)

When more than one advertisement appears on a page, the following code identifies the location of the ad on page: T-top, B-bottom, L-left, R-right, IFC-inside front cover, IBC-inside back cover, OBC-outside back cover.

MECHANICAL ENGINEERING—MARCH 1959—**Products Advertised**

1
2
4
8,9
10,11
12
13
14,15
16
17
18,19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
139
140
142
143
144
145R
146
147
148
149
151T
151B
152
153
154
157
158L
159L
159R
161
162L
162R
163
164L
164R
165
166
167
168
169
170L
170R
171
172
173,174
175
176,177
181
183
186
188T
188BL
188BR
189TL
189BL
189R
190
203
205
206
IFC
IBC
OBC

PLEASE SEND me more complete engineering information on the products advertised in the pages circled above.

NAME. . . . .

TITLE. . . . .

COMPANY. . . . .

ADDRESS. . . . .

CITY and STATE. . . . .

Code number identifies location of item in Keep Informed Section—beginning page 141.

MECHANICAL ENGINEERING—MARCH 1959—**Keep Informed Section**

K-1
K-2
K-3
K-4
K-5
K-6
K-7
K-8
K-9
K-10
K-11
K-12
K-13
K-14
K-15
K-16
K-17
K-18
K-19
K-20
K-21
K-22
K-23
K-24
K-25
K-26
K-27
K-28
K-29
K-30
K-31
K-32
K-33
K-34
K-35
K-36
K-37
K-38
K-39
K-40
K-41
K-42
K-43
K-44
K-45
K-46
K-47
K-48
K-49
K-50
K-51
K-52
K-53
K-54
K-55
K-56
K-57
K-58
K-59
K-60
K-61
K-62
K-63
K-64
K-65
K-66
K-67
K-68
K-69
K-70
K-71
K-72
K-73
K-74
K-75
K-76
K-77
K-78
K-79
K-80
K-81
K-82
K-83
K-84
K-85
K-86
K-87
K-88
K-89
K-90
K-91
K-92
K-93
K-94
K-95
K-96
K-97
K-98
K-99
K-100
K-101
K-102
K-103
K-104
K-105
K-106
K-107
K-108

PLEASE SEND me more complete engineering information on the items featured above.

NAME. . . . .

TITLE. . . . .

COMPANY. . . . .

ADDRESS. . . . .

CITY and STATE. . . . .

Need more engineering information on products featured in this issue?

USE THE POSTAGE-FREE CARDS . . .

If you would enjoy receiving additional engineering information on any of the products

advertised in this issue or
detailed in the Keep Informed Section

. . . . circle the page numbers of these advertisements or items . . . . fill in your name and mail to us. Your requests will be promptly forwarded. All information will be directed to you.

(Note: Students please write direct to manufacturer.)

FIRST CLASS
PERMIT No. 1144
NEW YORK, N.Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

MECHANICAL ENGINEERING
29 West 39th Street
New York 18, N.Y.

MAIL THIS CARD

after circling the page numbers and filling in your complete address.
NO POSTAGE REQUIRED

FIRST CLASS
PERMIT No. 1144
NEW YORK, N.Y.

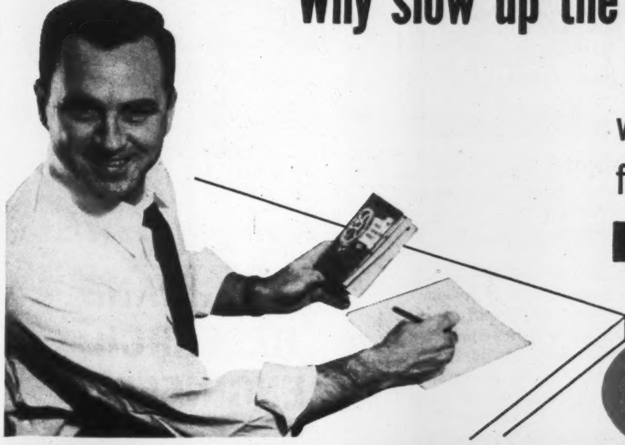
BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN THE UNITED STATES

MECHANICAL ENGINEERING
29 West 39th Street
New York 18, N.Y.

MAIL THIS CARD

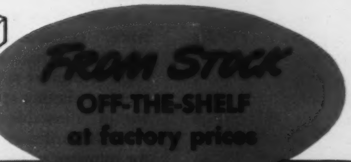
after circling the item numbers and filling in your complete address.
NO POSTAGE REQUIRED

"Why slow up the job with special gears?"

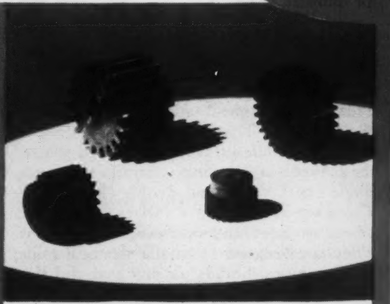


when you can select what you need from over 2000 standardized

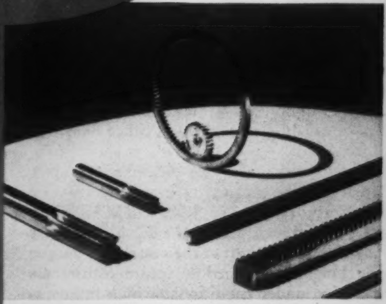
BOSTON GEARS



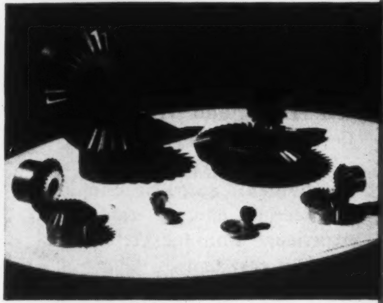
SPUR GEARS — STEEL, IRON, BRASS
14½° and 20° P.A. .208" to 40" P.D.



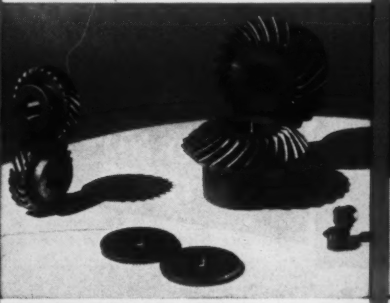
NON-METALLIC SPUR GEARS
14½° and 20° P.A. .938" to 6.667" P.D.



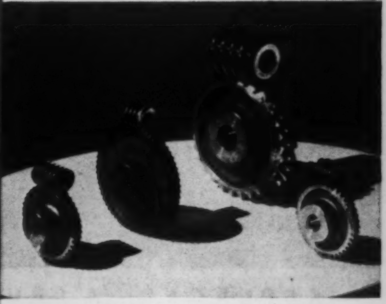
RACK • PINION WIRE
Steel and Brass 14½° and 20° P.A.
PINIONS • INTERNAL GEARS



BEVEL and MITER GEARS
Steel, Iron, and Brass 20° P.A.
.312" to 14" P.D.



STEEL SPIRAL MITERS 1" to 5" P.D.
HELICAL GEARS
Steel and Bronze .333" to 6" P.D.



WORM GEARS Bronze and Iron
.417" to 18" P.D. **WORMS** .333" to 4" P.D.
Soft Steel and hardened and ground steel

9496

STANDARDIZED TRANSMISSION PRODUCTS

- Stock Gears
- Sprockets and Chain
- Speed Reducers
- Bearings • Couplings
- Shaft Supports
- Pulleys

BOSTON Gear
COMPLETE CATALOG
POWER TRANSMISSION PRODUCTS
From Stock!
BOSTON Gear

Take a good look through the BOSTON Gear catalog. You'll find standardized types and sizes to fit most of today's transmission needs. Why pay more (and wait) for gears made to order? Design around BOSTON Gear. It saves time and money in planning, in purchasing, in production . . . and you simplify servicing problems. Boston Gear Works, 66 Hayward Street, Quincy, Mass.

CALL YOUR
BOSTON Gear
DISTRIBUTOR

— STANDARDIZATION PAYS —

For nearest Distributor LOOK UNDER "GEARS" in the 'Yellow Pages'

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Single Phase Motors

A new bulletin published by Robbins & Myers, Inc., Motor Div., describes its new, expanded line of integral horsepower single phase motors.

Available in ratings from $^3/_4$ to 20 hp, the new line includes open protected, totally enclosed fan cooled and explosion proof frames. The bulletin outlines the firm's weatherizing treatment to make the motors suitable for use in damp, dirty, or corrosive atmospheres without the need of other protection. Tabulated ratings, dimensions and weights are included. **—K-41**

Trickle Valves

Ducon Co., Incorporated announces the availability of a four-page bulletin, V-1458, describing its Type CA trickle valve, a positive gas-tight seal for material return dip-legs in catalyst recovery and other fluid bed processes.

The firm says the valve increases catalyst density in the dip-leg by more than 50 per cent, improving through-out and eliminating the need for lengthening the dip-leg and thus increasing the height of the vessel. A unique ring hinge is designed to insure continuous operation under conditions of high temperature, corrosion, and erosion and coking. **—K-42**

Power Piping Designs

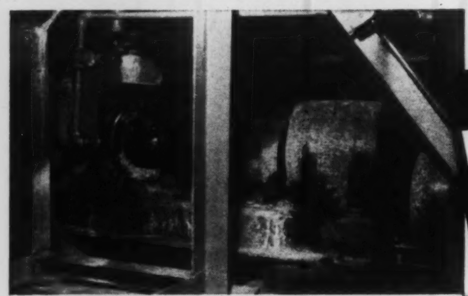
A brochure published by M. W. Kellogg Co., Subsidiary of Pullman Inc., describes the latest computer methods of analyzing power piping designs.

The 8-page brochure shows how power piping flexibility experts make recommendations based on computer results and experience. It explains how the firm's engineers determine whether forces acting on equipment will meet supplier's guarantee requirements; whether stresses at various points are within allowable ASA code ranges; and whether sufficient clearances are available for unrestrained pipe movements. **—K-43**

Quick-Seal Couplings

An illustrated 20-page catalog, in color, describing its line of quick-seal couplings for hydraulic and pneumatic applications, has been issued by Titeflex, Inc.

The new bulletin, No. Q.S.R. 58, discusses three types of couplings: straight-through, single check-valve, and double check-valve. These are available in a variety of sizes and alloys to meet any operating requirement. They are designed to handle chemicals, oils, greases, gases, liquids, or any material that will flow through a line, the bulletin states. **—K-44**

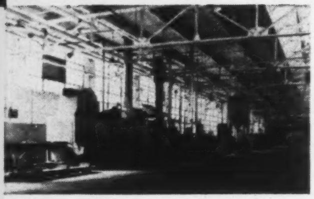


This
Nagle Pump
IN OPERATION
2 YEARS

—REPLACED A PUMP THAT LASTED 2 MONTHS

A leading manufacturer of household appliances* installed this Nagle 1" type H-A-W horizontal shaft pump over 2 years ago and it's still going strong. It is in the Bonderizing Dept., shown, handling phosphate slurry at the rate of 10 GPM, against a 25' head. Pump is self-priming. Simple slippage seal adjustment. Readily accessible stuffing box. Pump it replaced lasted less than two months. If you have an abusive pumping problem Nagle Pumps can cut your costs too! Send for "Pump Selector".

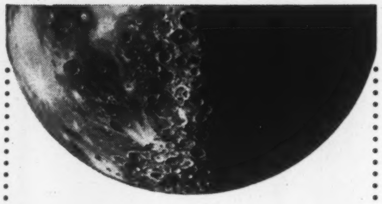
*Details on request.



NAGLE PUMPS

NAGLE PUMPS, INC.
1299 CENTER AVE., CHICAGO HEIGHTS, ILL.

PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS



We need
DESIGN AND RESEARCH ENGINEERS
for our
THRUST CHAMBERS GROUP

The major engineering endeavor in this group is in the fields of fluid flow, gas dynamics, combustion, and heat transfer.

The duties of the new design engineer will be to design and layout thrust chambers and assemblies, injectors and ignition systems.

The duties of the new research engineer will be to establish thrust chamber evaluation requirements, monitor tests, evaluate and analyze test results, and write complete development reports.

He must have a BS or MS in mechanical, aero, or chemical engineering—and preferably some experience with rockets or other propulsion systems.

Please write: Mr. E. C. Jamieson, Engineering Personnel Department, 6633 Canoga Ave., Canoga Park, California.

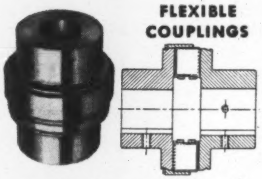
ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.
FIRST WITH POWER FOR OUTER SPACE

Lovejoy

POWER TRANSMISSION EQUIPMENT
EASILY INSTALLED, MAINTENANCE-FREE

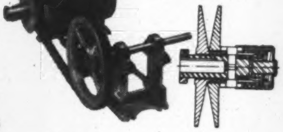
FLEXIBLE COUPLINGS

REQUEST CATALOG C-58



Bores (max.)..........5/16" to 9½"
O.D. ....5/8" to 21½"
Wt. ....½ oz. to 1500 lb.
H.P. ....1/20 to 4250
Torque (static). 1½ to 5100 ft.-lbs.

VARIABLE SPEED PULLEYS



REQUEST CATALOG P-58

Bores (max.)..........½" to 1⅝"
O.D. ....3" to 13⅝"
Belt Sizes............A to 2¾ TW
Speed Ratios...........1-1 to 8-1
H.P. (1750 rpm.).........¼ to 15

UNIVERSAL JOINTS

REQUEST BULLETIN 820

Bores.....................¼" to 2"
Hub Dia. ....½" to 4"
Static Torque
340 to 130700 in.-lbs.
H.P. (100 rpm.).........½ to 207

SHAFT MOUNTED GEAR REDUCERS

REQUEST CATALOG R-58

18 Models From Stock
Speeds...........8 to 425 R.P.M.
H.P. ....Fractional to 120
Ratios.....Single 4.5:1 Nominal
Double 14.7:1 Nominal
Hollow Shafts.......1 7/16 to 5 5/16 in.

LOVEJOY FLEXIBLE COUPLING CO.

4832 WEST LAKE STREET • CHICAGO 44, ILLINOIS

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Control Cabinets

Air conditioning zone control cabinets are described and illustrated in Bulletin AC-220 issued by Buffalo Forge Co.

Separate sections with tables, curves, and sketches cover proper unit selection, physical data, dimensions, fan performance, and coil ratings for water cooling, direct expansion, hot water, and steam. **—K–45**

Recorders, Controllers

A six-page folder on automatic dew point recorders and controllers is announced by Surface Combustion Corp.

Autocarb systems for control of carbon potential and their applications are described; installation photos, illustrations of the new standardized line of control instruments and a chart for selecting proper system are included. **—K–46**

Temperature Controller

Details on its Series 541 temperature indicating controller are included in a folder issued by Fenwal Inc.

The four-page brochure describes the various controller housing and switching arrangements, covering temperature ranges from −150 to 700 F and current ratings up to 20 amp 125 vac. Dimensions and modifications are given. **—K–47**

Valves, Fittings, Supplies

Frick Co. has issued a catalog covering the prices of valves either singly, or complete with either screwed or welding-neck flanges.

Pipe nipples, hanger fittings, and other new items have been added. Valve parts are shown in special tables which feature every piece, and the allowable working pressures are given for all the equipment. **—K–48**

Carbon, Graphite Applications

A description of its line of carbon, graphite, and impervious carbon and graphite equipment for chemical processing applications is available from National Carbon Co. Div. of Union Carbide Corp.

The four-page illustrated bulletin discusses each of a wide range of products, and refers to specific catalog sections that contain complete technical data. **—K–49**

Needle Thrust Bearings

Catalog 759, covering needle thrust bearings with increased capacity ratings, is offered by Torrington Co.

The material is the result of three years' extensive laboratory testing, combined with field tests in customers' products. It discusses installation, lubrication and load capacity of the bearings and design and installation of the thrust races for use with them. **—K–50**

From start to finish—fastening problem solutions

If you have a fastener problem in designing that new bridge, electronic computer or whatever your project, consider first this one *big* point. The fastener for your application may have already been produced. Think what a savings that would mean in both time and cost. Contact your Pittsburgh Screw & Bolt representative—he can tell you which of our unlimited supply of standard fasteners can best solve your problem. It will pay off for you.

VMA 6475

PITTSBURGH SCREW AND BOLT CORPORATION
P.O. Box 1708
Pittsburgh 30, Pa.

DIVISIONS
Gary Screw and Bolt—Chicago, Ill.
Southington Hardware—Southington, Conn.
American Equipment—Norristown, Pa.

America's Most Complete Line of Industrial Fasteners

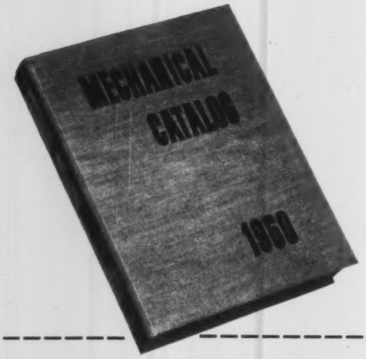
Do you sell to engineers?

If you do then you'll be interested in the year-round sales power of the MECHANICAL CATALOG . . . *the* source of supply to the mechanical industries. Most of the reliable barometers predict a substantial upturn in the economy for the next 12 to 24 months . . . but even though business is better it's a safe bet selling won't be any easier. It's a buyers market! To reach *the* buyer and specifier of mechanical equipment you'll want to have your message in the 1960 MECHANICAL CATALOG:

. . . A permanent reference book reaching 18,500 graduate mechanical engineers . . . our highest circulation in 25 years.

. . . A combined catalog and directory listing over 3500 manufacturers . . . all the known sources of supply for 6000 engineered products: equipment, parts and material.

For further advertising information, detatch and mail in the coupon printed below



Mail to **MECHANICAL CATALOG, 29 West 39 Street, New York 18, N.Y**

Name..

Title..

Company..

Company address..

City.................................... State..

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Jacketed Stainless Valves

Bulletin No. 3 describing a line of 150 and 300 lb fully jacketed stainless steel valves designed for fluids difficult to move at room temperatures has been issued by Alloy Steel Products Co.

All valves are integrally cast in a wide range of corrosive resistant alloys. Sectional views show gate, globe, and check valve designs illustrating extensive jacketing which includes bonnet areas. Teflon disk designs and flanged fittings are described and illustrated. **—K-51**

Jigs, Fixtures

An 84-page catalog said to be a complete source for data on all the standards for tool, die, jig and fixture design and applications is available from Jergens Tool Specialty Co.

The catalog gives specifications and cost-saving data on more than 2000 units, including work-holding equipment, chuck jaw blanks, handles, knobs, wheels, strap clamp assemblies, forged items and other jig and fixture components. Specifications and engineering drawings with tracing templates available are included. **—K-52**

Variable-Speed Drives

An eight-page bulletin, G-5812, describes the line of Reeves variable-speed drives designed to provide precise, infinitely adjustable output speeds from a constant rpm motor source operating from standard in-plant a-c circuits.

The bulletin includes mechanical construction features, condensed drive specifications, available speed variations and accessories for the firm's vari-speed Motodrive, motor pulley and variable-speed transmission. **—K-53**

Fan-Cooled Worm Gear

Mounting for top, bottom, vertical, sidewall or angled drive of Verso worm gear speed reducers is described in a bulletin published by De Laval Steam Turbine Co.

Horsepower and torque data for Verso worm gear units built on $2^1/_2$ up to 4-in. centers are given in full-page tables. Speed reduction ratios ranging from 70:1 to 5:1 are available for heavy-duty industrial applications where continuous running under demanding service is required. **—K-54**

Reducer Motors

A revised, 12-page bulletin, published by Bodine Electric Co., lists and describes 300 standard stock reducer and nonreducer motors of various types and sizes.

Horsepower ratings of nonreducer motors listed range from $^1/_7$ to $^1/_{1500}$. Reducer motors, with speeds ranging from 833 to 0.7 rpm, have torques of 12.8 in-oz to 219 in-lb. **—K-55**

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Sling Chains

The firm's line of registered sling chains—1-leg, 2-leg, 3-leg and 4-leg styles plus necessary hooks and attachments—manufactured by American Chain Div., American Chain & Cable Co., are described in 28-page Catalog DH-105.

The catalog lists such points as ordering information, safety factors to consider when ordering sling chains, specifications, care, table of wear, and inspection procedures. **—K-56**

Precision Gears

High-performance, precision gears from less than one inch to over 200 inches in diameter and with tooth-to-tooth spacing accuracies of two ten-thousandths of an inch are described in General Electric's new bulletin GEA-6430.

Typical applications include high-speed industrial gear units, marine gear units, aircraft power and accessory gears, rocket and missile gears, radar power and data gears, guidance control gears, gun positioning gears and test stand gear systems. **—K-57**

Sheet Metal Notching

A catalog released by Wales-Strippit, Inc., a unit of Houdaille Industries, Inc., shows a variety of notching operations which can be readily set up in stamping presses and press brakes in unlimited patterns.

The new Catalog N covers 90 deg corner notching, louver notching, fulcrum notching for angles, and edge notching. It also describes the new standardized edge notching units which are now being manufactured with standard stock punch bodies, punch caps, and die holders. **—K-58**

New Storage Unit

A descriptive data sheet, No. 573, covering a new high-capacity, demand-type storage unit has been released by Gear-O-Mation Div., Michigan Tool Co.

The storage unit, for all types of parts that roll, uses a parts elevator and zig-zag retaining tracks to store and/or feed up to 3000 parts. The two-page data sheet uses photographs to describe the equipment. Also included are specifications, capacities, and a description of the storage unit's operation and application. **—K-59**

Aluminum Data

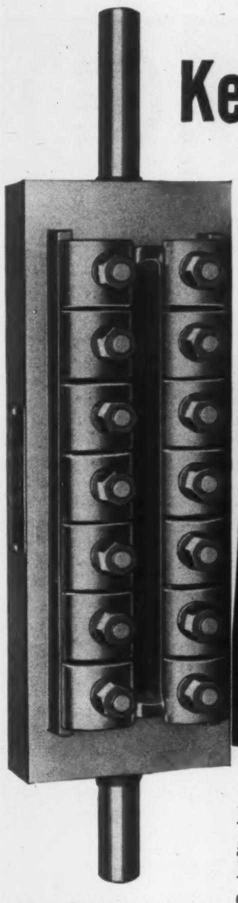
Joseph T. Ryerson & Son, Inc. announces a new edition of 256-page, pocket size data book.

It includes aluminum analyses, characteristics, mechanical properties and tolerances, which are in addition to previously published information on steel. Machining and fabricating data, manufacturing practices and tolerances, weights, safe loads, ASTM standards, compositions and properties, and miscellaneous facts are provided. **—K-60**

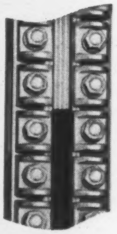
Keep the "eyes" of your boilers safe

... to protect life and property

Use
Reliance Water Gage Inserts
for leak-tight shatter-proof service



New Reliance Mica-protected Flat Glass Gage Insert for steam pressures to 1500 psi. Rigid wide body; improved Reliance finger-type clamping principle.



Reliance PRISMATIC Gage Insert shows sharp black-white contrast between water and steam. Models for pressures to 350 psi.

It's false economy to "scrimp" on water gages. These vital basic checks on water levels should be of highest quality, assuring continuous clear reading, and safety for workers and equipment . . . A few hints worth considering:

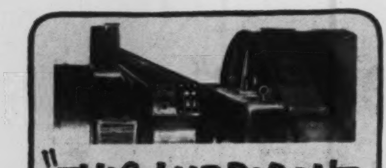
1. See that you have gage inserts on all boilers and supplementary vessels corresponding with the design pressure.
2. Insist on frequent inspections and maintenance to *prevent* trouble.
3. Keep spare inserts and replacement parts on hand for prompt use when needed. (Many plants use spare inserts when necessary to keep gages in continuous service — make repairs when convenient.)

Reliance, oldest manufacturer *specializing* in boiler safety equipment, makes water gage components for all pressures, any visibility range. Also direct-to-drum assemblies. Extra strength — a generous margin of safety — is built into all Reliance products. When you write, please mention your working pressure.

The Reliance Gauge Column Co.
5902 Carnegie Avenue • Cleveland 3, Ohio

Reliance® BOILER SAFETY DEVICES

1884 75th YEAR 1959



"THIS LUBRICANT ENABLED US TO INCREASE PRODUCTION"

says—PITTSBURGH TUBE COMPANY

"Our 70,000 pound Draw Bench was designed to operate at a maximum of 80 feet per minute, full load. We decided to increase the drawing speed on lighter tubing to 100 and 104 feet per minute. This overloaded the Speed Reducer, however, causing it to overheat. We tried four different makes of oils without success before trying LUBRIPLATE A.P.G. 90. With LUBRIPLATE, we are able to pull heavier tubing than before at 104 feet per minute without the Reducer overheating."

R. S. Vorous
Maintenance Engineer

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE GREASE AND FLUID TYPE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

LUBRIPLATE
H.D.S.
Motor Oil

LUBRIPLATE is available in grease and fluid densities for every purpose . . . LUBRIPLATE H. D. S. MOTOR OIL meets today's exacting requirements for gasoline and diesel engines.

For nearest LUBRIPLATE distributor see Classified Telephone Directory. Send for free "LUBRIPLATE DATA BOOK" . . . a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

THE MODERN LUBRICANT
"It's the Film"
PREVENTS WEAR AND CORROSION
LUBRIPLATE
SUPER-LUBRICATION
FISKE BROTHERS REFINING CO.
NEWARK N. J.
TOLEDO OHIO

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Pneumatic Grinders

Catalog PT-58, published by Thomas C. Wilson, Inc., provides data on the firm's recently-introduced line of portable pneumatic grinders.

The 12-page, illustrated, loose-leaf type catalog gives data on pneumatic die grinders, designed for use in tool and die shops, machine shops, pattern shops, or wherever filing grinding, cutting, and polishing are performed. Data is given on four models, two of which have a speed of 60,000 rpm and two of 40,000 rpm. Subsequent pages are devoted to horizontal grinders, available in various sizes and models with speeds from 3100 to 12,000 rpm. **—K–61**

Power Transmission

A four-page bulletin describing its line of power transmission equipment is available from American Pulley Co.

The bulletin contains a brief description of the major features of speed reduction drives; screw conveyor drives; adjustable speed drives, both standard and wide range; motor bases; and conveyor and split pulleys. The complete range of sizes is listed for each piece of power transmission equipment. **—K–62**

Master Reference

A brochure describing the 2-Gyro all attitude master reference, said to be the simplest integration of gyro elements required to produce a completely all attitude control reference providing no-gimbal-lock roll, pitch and azimuth outputs, is available from Lear, Inc., Contracts Dept.

The unit is described as featuring production proven components, high accuracy directional gyro, electrolytic erection system, fail safe design and geocentric vertical reference capability. **—K–63**

V-Belt Drives

A 44-page bulletin, A-695, by Dodge Mfg. Corp. describes a new line of V-belt drives claimed to be smaller, cost less, weigh less, and require less space than conventional V-belt drives.

Illustrated with photographs and engineering drawings, the bulletin explains construction features of the new Dyna-V sheaves and V-belts, said to deliver up to three times as much horsepower in a given space. Table of pre-engineered drives are included. **—K–64**

Use a CLASSIFIED ADVERTISEMENT
for Quick Results

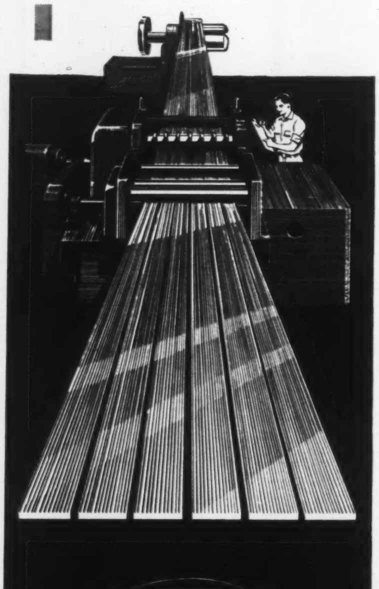
YODER

Rotary Slitters

Product dependability—integrity of manufacture—engineering for specific production needs have all contributed to establish Yoder equipment as the industry standard of excellence. Since 1909 Yoder-built machinery, including Pipe and Tube Mills, Roll Forming Equipment and Rotary Slitters, have earned world-wide customer satisfaction and recognition.

Profit from Yoder's years of engineering and service experience. Send today for the illustrated Yoder Slitter Book.

THE YODER COMPANY
5499 Walworth Ave., Cleveland 2, Ohio



ENGINEERING
YODER
MANUFACTURING

ROTARY SLITTING LINES
PIPE AND TUBE MILLS
(ferrous or non-ferrous)
COLD ROLL FORMING MACHINES

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Automatic Fuel Burner

Peabody Engineering Corp. has available an eight-page, two-color brochure, No. 430B, describing its completely redesigned PK-54 burner. **—K-65**

Cold Saws

A 12-page bulletin describing cold saw machines for cutting ferrous and nonferrous metals is available from Consolidated Machine Tool Div., Farrel-Birmingham Co.

Machine sizes, given in saw-blade diameters, range from 32 to 120 in. The machines are built for special cutting operations. Cutting speed, spindle horsepower, type of spindle drive and design of work-clamping device are determined by specific production requirements, the firm states. **—K-66**

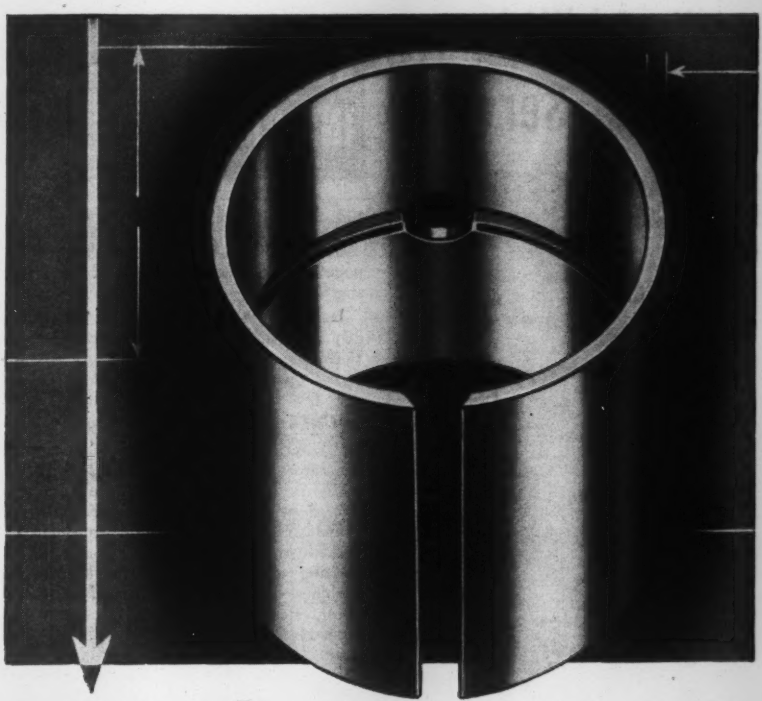
Standard Fasteners

A fastener-recognition bulletin is offered by Standard Pressed Steel Co.

Putting names to the shapes of more than 70 different fasteners which are normally specified for aircraft, missile, engine, and related applications only by their national standard (NAS, AN, MS) designations, the literature spot-illustrates each with identifying front-and-side view sketches and tells what type fastener it is. **—K-67**

V TOWARD GREATER VICTORIES

JOIN THE MARCH OF DIMES



extremely rigid specifications!

●●●●●●●●

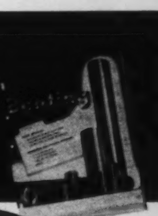
The illustration shows the cast bronze spindle bearing of a very well-known and popular metal-working lathe.

The manufacturer of this lathe has extremely rigid specifications covering tolerances, finish, structural quality of the bronze and roundness of the bearing even though the bearing is split for its entire length.

A manufacturer with such requirements naturally turns to Bunting to satisfy them.

For the unusual, as well as the usual, in bearings, bushings, bars or special parts of cast bronze or sintered metals, see Bunting first.

BUNTING SALES ENGINEERS in the field and a fully staffed Product Engineering Department are at your command without cost or obligation for research or aiding in specification of bearings or parts made of cast bronze or sintered metals for special or unusual applications.



...ask or write for your copy of...

Bunting's "Engineering Handbook on Powder Metallurgy" and Catalog No. 58 listing 2227 sizes of completely finished cast bronze and sintered oil-filled bronze bearings available from stock.

Bunting.

The Bunting Brass and Bronze Company • Toledo 1, Ohio • EVergreen 2-3451
Branches in Principal Cities

BEARINGS, BUSHINGS, BARS AND SPECIAL PARTS OF CAST BRONZE OR SINTERED METALS.

World-Wide Chimney Service

New Chimney design and erection

Radial Brick

Reinforced Concrete

Old Chimney repair and restoration

High Temperature and Acid Proof Linings

PABRIK SEMEN GRESIK

New, reinforced concrete chimney 175 ft. x 14 ft. 6 in. for cement plant of Pabrik Semen Gresik Company, Indonesia.

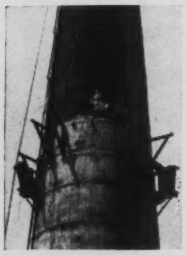
Designed by experienced chimney engineers to provide the correct height, diameter and type for highest boiler efficiency with lowest possible fuel cost. Designs, specifications, plans and recommendations furnished to meet your individual requirements.

Perforated radial brick of refractory clay molded to conform to chimney radius; joints broken vertically and horizontally.

Reinforced concrete employing adjustable steel forms both inside and outside to provide exceptionally sturdy construction, speedy and economical erection.

WE ARE CHIMNEY SPECIALISTS

with more than a quarter-century of successful design and construction for major utilities, institutions, processing and manufacturing plants in the United States, Canada, Mexico, and many foreign countries. Additional chimneys have also been designed and erected for these organizations as their power requirements have increased.



Restoration work on concrete chimney showing new material being bonded before waterproofing.

OUR SERVICES INCLUDE:

Acid Proof and Other Linings
Linings for Steel Stacks
Waterproofing
Concrete Restoration
Guniting
Installation of Lightning Rods and Aircraft Warnings
Demolition

Whatever your chimney problem may be, Consolidated has the experience, knowledge and trained personnel to correct it.

Phone, wire or write today for information. Ask for catalog illustrating representative installations, listing engineering service and giving chimney design data.

CONSOLIDATED CHIMNEY CO.
ENGINEERS AND BUILDERS
6 So. Dearborn Street, Chicago. RAndolph 6-6223
545 Fifth Avenue, New York. Murray Hill 7-6867
Detroit • Cleveland • Minneapolis • Richmond, Va.
Houston • Toronto, Canada

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Mechanical Seals

Borg-Warner Corp. has published a four-page bulletin describing its line of precision shaft seals.

Ranges for standard types are given, and engineered models offered for other applications. **—K-68**

Turbine-Generators

A 40-page booklet describing turbine-generators from 5000 kw to 100,000 kw for industrial and electric utility applications is offered by the Westinghouse Electric Corp. Standard and special features are described and illustrated. The booklet contains data relating to condensing and noncondensing turbines, blading, shrink fitted disks, steam chest, steam seals, nozzles, bearings, and rotors. A description is given, with diagrams, of the hydraulic governing system. **—K-69**

Manifold Distribution

Production, space and cost benefits in continuous distribution of industrial gases by custom-built manifold installations are described in a 28-page brochure available from National Cylinder Gas Div., Chemetron Corp.

Duplex, simplex, and portable manifold distribution systems piping oxygen, hydrogen, nitrogen, helium, argon, acetylene, and other gases for uses such as welding, cutting, heating, flame hardening, flame blasting, and oxygen lance operations are detailed. **—K-70**

Heating, Ventilating

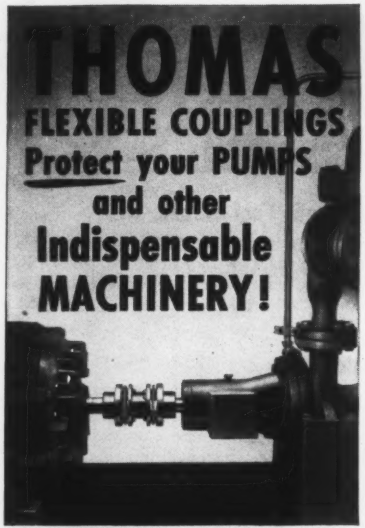
American Air Filter Co. announces the release of a new product bulletin describing its line of Herman Nelson heating and ventilating units.

The units are available in 12 sizes with capacities ranging from 600 to 73,000 cfm. Coils used in the unit are normally mounted in the fan section, which will accomodate up to a two-row coil, steam or hot water, large or small face area. For more than one coil, or more than two rows, a separate coil section is used. **—K-71**

Control Valves

Conoflow Corp. has just issued a new bulletin describing the company's line of Series LB control valves.

The 12-page booklet gives details on construction and operating characteristics. It points out how the combination of single-seated valve body and rugged cylinder actuator of the valve outmodes conventional diaphragm motor valves. Design features, including an extra thick body wall which meets 600 lb ASA rating in all sizes, are discussed. **—K-72**



NO LUBRICATION
NO MAINTENANCE
NO WEARING PARTS

Future maintenance costs and shutdowns are eliminated when you install Thomas Flexible Couplings. These all-metal couplings are open for inspection while running.

They will protect your equipment and extend the life of your machines.

Properly installed and operated within rated conditions, Thomas Flexible Couplings should last a lifetime.

UNDER LOAD and MISALIGNMENT ONLY THOMAS FLEXIBLE COUPLINGS OFFER ALL THESE ADVANTAGES:

- Freedom from Backlash
- Torsional Rigidity
- Free End Float
- Smooth Continuous Drive with Constant Rotational Velocity
- Visual Inspection While in Operation
- Original Balance for Life
- No Lubrication
- No Wearing Parts
- No Maintenance

Write for Engineering Catalog

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Castings Applications

Meehanite Metal Corp. announces a 32-page booklet that provides a cross-section of the scope of the applications of the firm's castings.

The booklet contains 43 illustrations showing applications covering almost every major industry and gives table of physical properties of the types of metals available. —K-73

Chemical Pumps

Milton Roy Co. has published a four-page bulletin describing its line of controlled volume miniPumps for metering chemicals in minute volumes against pressures.

The pumps will meter as little as 3 ml/hr with an accuracy of ±2 per cent. Bulletin 1257-1 contains specifications on laboratory, industrial, and chromatographic designs. Maximum capacity is 7880 ml/hr against pressures to 1000 psi. —K-74

Vacuum Filters

How the firm's Vacu-Matic filters employ a new vacuum method designed to provide unusually high flow rates in continuous filtration of machine tool water soluble oil coolants is described in a brochure released by the U. S. Hoffman Machinery Corp.

The automatic and self-cleaning filter is said to make high speeds, faster feeds, better finishes possible as it removes all chips abrasives, dirt, other solid contaminants with minimum coolant loss and greatly reduced shut-down. —K-75

Axial Blower

A new high efficiency axial blower that will deliver up to 169 cfm and can deliver 100 cfm against a static pressure of 3.5 in. of H_2O, is described in Bulletin X-1530 published by Globe Industries, Inc.

The units are designed to meet appropriate MIL specs and are powered by the firm's Type FC motor and operate at 115 v or 200 vac, 400 cycles, 3-phase. Housing and propeller are precision cast of aluminum. The motor is cooled by the airstream.

Power input at peak air volume is 120 w. Three mounting options are available: by clamp to servo flanges, by an outside diameter clamp, or by use of a special flange. —K-76

Tube Form Mountings

A 12-page product bulletin describing full bonded tube form mountings and Dynaflex joints, specially engineered for vibration and shock control, is now available from Lord Mfg. Co.

Bulletin No. 713 contains an application guide, performance characteristics and data, detailed specifications, typical applications and methods used for selection and installation. —K-77

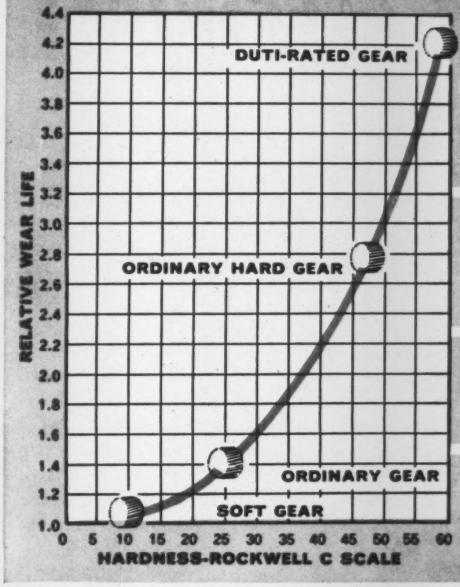
HERE'S WHY FOOTE BROS.

Duti-Rated

LIFETIME GEARING

GIVES BETTER PERFORMANCE
...LONGER LIFE

GEAR PERFORMANCE COMPARISON CHART

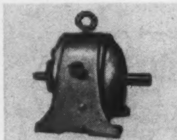


DUTI-RATED GEAR— Hardened after cutting. Precision processing permits maximum hardness while holding accuracy within extremely close tolerances.

ORDINARY HARD GEAR— Hardened after hobbing and shaving; hardness limited to maintain reasonable accuracy.

ORDINARY GEAR— Hardened before cutting; hardening limited to maintain machinability.

SOFT GEAR— Low hardness—excessive size required because of low capacity.



LINE-O-POWER Speed Reducer

AND YOU GET
Duti-Rated
Gearing in These
Foote Bros. Drives

LINE-O-POWER Right Angle Drive

SHAFT-MOUNTED Drive

LINE-O-MOTOR Drive

Vertical LINE-O-MOUNT Speed Reducer

Write for SHAFT MOUNTED and LINE-O-POWER Catalogs
See how You can get more for Your Drive Dollar!

100 YEARS SERVING INDUSTRY 1859-1959

FOOTE BROS.

Better Power Transmission Through Better Gears

FOOTE BROS. GEAR AND MACHINE CORPORATION
4559 SOUTH WESTERN BOULEVARD • CHICAGO 9, ILLINOIS

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Nitric Acid Plant

A four-page brochure describing the engineering and construction of a nitric acid concentration plant of a new and improved design is available from Badger Mfg. Co.

The plant, built by the firm for Hercules Powder Co. produces a 99+ per cent concentrate. The brochure includes flow chart and description of process, engineering and construction details, information on process licensing. **—K-78**

Strip Chart Recorder

Specification 153-20, covering details of its ElectroniK strip chart recorder with continuous integration, is announced by Minneapolis-Honeywell Industrial Div.

This new potentiometer measures, records, and totalizes the area under each peak of a chromatography spectrum. The firm points out that although the recorder-integrator was developed primarily for gas chromatography analysis, it is applicable in such other fields as measurement of power consumption in power line networks, continuous weighing systems and electric current measurements in aluminum pot lines. **—K-79**

Alloy Wire Cloth

International Nickel Co., has issued a new booklet on the use of wire cloth for filters, dipping baskets, core-support structures and other applications.

The booklet describes the physical advantages of wire cloth and indicates the range of weaves and sizes available for various purposes. Mechanical properties of "A" nickel, Monel nickel-copper alloy, Inconel nickel-chromium alloy, and Incoloy iron-nickel-chromium alloy—four standard materials for wire cloth and knitted mesh—are given, along with a listing of the products which are commonly filtered with wire cloth of those materials. **—K-80**

Belt Conveyor Idlers

Book 2716, available from Link-Belt Co., contains detailed engineering selection data on five new series and 23 types of belt conveyor idlers and illustrates their versatility for a wide range of conveyor applications.

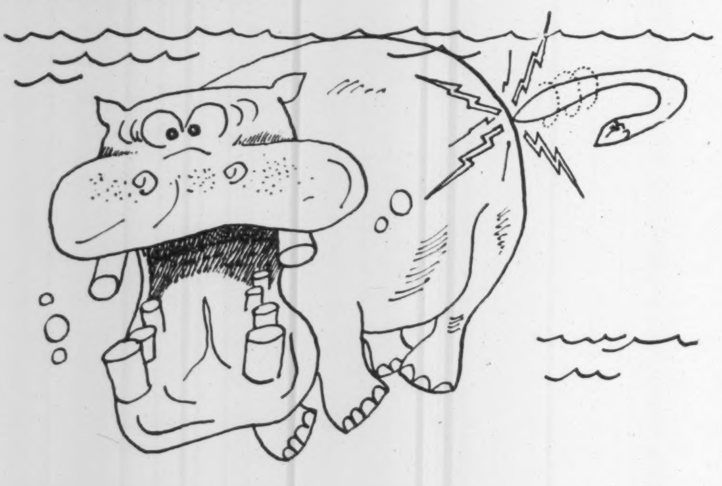
The new 40-page book lists the line of idlers now being manufactured by the company for belt widths of 14 to 84 in. All idlers are equipped with inverted angle bases and removable steel retainer clips that hold idler rolls securely in position. A grease-through feature permits lubrication of all rolls simultaneously from a single fitting. **—K-81**

Corrosion Data

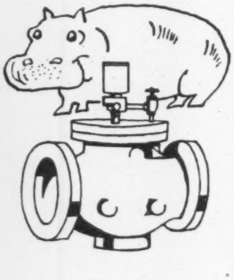
A guide to the corrosion-resistance of alloys is available from Haynes Stellite Co., Div. of Union Carbide Corp.

Charts and graphs show penetration rates for the alloys in over 250 corrosives. The booklet provides a reference for Hastelloy alloys, Haynes alloy No. 25, and Multimet alloy. Corrosives on which data has been gathered range from acetaldehyde to zinc sulphate. **—K-82**

OPENS ON ELECTRICAL IMPULSE



G-A *Cushioned* Solenoid Operated Valve



Where remote control valve operation is desired, specify and use the G-A Cushioned Solenoid Operated Valve that automatically opens or closes on any type of electrical impulse. The operating sequence—whether on open or closed circuit—can be made to suit your requirements. Sizes 2″ to 36″.

Bulletin W-7A has the complete story.

GOLDEN ANDERSON Valve Specialty Company
1223 RIDGE AVENUE, PITTSBURGH 33, PA.
Designers and Manufacturers of VALVES FOR AUTOMATION

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Coated Abrasives

An information kit on specifying coated abrasives is available from Carborundum Co.

The kit includes a buyer's guide, selector charts for metalworking and woodworking operations, and brochures on coated abrasives for the metalworking and woodworking trades. **—K-83**

Gear Shaving Machines

Two rotary external gear finishing machines are detailed in a four-page brochure, 870-A-58, available from Michigan Tool Co.

The machines shave gears by cutting away metal in tiny, hair-like chips with a serrated rotary cutter to provide a high surface finish. Close-up photos illustrate the underpass, modified underpass and transverse gear shaving methods. A short discussion on crown shaving is presented. **—K-84**

Hoist Safety Switch

W. C. Dillon & Co. has issued an illustrated bulletin describing Dyna-Switch, which automatically cuts the power supply when a hoist or crane approaches the overload stage.

Photos, schematics, and text describe the unit's operation, give prices, and outline applications for safeguarding personnel and equipment. **—K-85**

Socket Screw Products

A 28-page catalog on socket screw products has been published by Set Screw & Mfg. Co.

Included are recently introduced Setko socket shoulder screws, flat heads, button heads and dowel pins. Also shown is the expanded line of cold forged socket head cap screws. A feature of the new catalog is the inclusion of the firm's self-locking set screw selector chart. More than 1001 combinations of metals, locking actions, points, and suggested applications are covered. **—K-86**

Automatic Air Filter

Construction and operating characteristics of the firm's new Model B Roll-O-Matic automatic renewable-media air filter are described in a bulletin released by American Air Filter Co.

Featured is a description of what the manufacturer calls its "miracle" media—a 65-lineal-foot roll of impregnated, reinforced media composed of continuous, slightly curled, interlaced glass filaments that are held in place by a thermo-setting plastic bond to form a resilient pad or fluffy blanket having a nominal thickness of 2 in. The new media will not drip at temperatures up to 150 deg and will not lose its adhesive qualities to dryness, the company states. **—K-87**

Roller Gravity

Lamson Corp. announces the release of a new roller gravity handbook.

Illustrations and photos explain the application of gravity conveyors and accessories. Charts and graphs are included to assist in matching a conveyor to the loads. **—K-88**

Drafting Tables, Files

A catalog of drafting room equipment manufactured by Hamilton Mfg. Co., features presentation of the firm's complete line of drafting tables and files. Specifications are concise and simple. **—K-89**

ANOTHER WOLLENSAK **FIRST!**

Presenting
NEW 16 mm FASTAX
with
NEW High-Index Glass
2-Sided Prism

Another fine camera is added to the Wollensak FASTAX line, the WF-3T. This high-speed motion picture camera retains all of the fine reliable features of the time-tested FASTAX and incorporates a high index glass, 2-sided prism for greater camera efficiency. No other camera in the high speed field, with this speed range, has this feature.

Now only the WF-3T FASTAX delivers:

- ★ Overall sparkling picture quality
- ★ Higher resolution over the entire frame
- ★ More uniform frame density
- ★ 10% more frame height
- ★ 100 foot daylight loading
- ★ Faster, effective shutter speed
- ★ Speed range from 150 to 6,000 pps

***Plus*... viewfinder... timing light... cut-off switch**

Write for complete information and prices, Bulletin WF-3T.

WOLLENSAK
OPTICAL COMPANY • ROCHESTER 21, N. Y.

FOR THE FINEST IN PHOTOGRAPHY THE WORLD OVER · IT'S WOLLENSAK

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Flexible Couplings

Acme Chain Corp. has issued a catalog on flexible couplings. It contains information on the various types of couplings and lists dimensions, list prices, and horsepower ratings. **—K-90**

Plug Valve Actuators

A 22-page brochure which gives data on plug valve actuators has been announecd by Pantex Mfg. Corp.

Included are specifications, dimensions, torque information and selection tables. **—K-91**

Corrosion Prevention

Bulletin 93XG, describing a series of techniques developed through the use of properly treated pure metals which are firmly bonded to a steel base by metallizing, is announced by Metallizing Engrg. Co. The metal coatings are claimed to assure low cost positive protection against oxidation for 25 to 100 years. In addition to describing the systems, the bulletin pictures typical applications on a broad range of equipment and structures. **—K-92**

Stainless Condenser Tubing

A technical report on a successful application of light wall stainless steel tubing for main surface condensers in power plants is available from Alloy Tube Div. Carpenter Steel Co.

The 10-page report combines interpretive text material, tabular test data, and performance curve graphs on an installation in a large Eastern power plant. The report explains how, under actual operating conditions, stainless' heat transfer characteristics equal, or surpass, those of admiralty metal. Also discussed is stainless' resistance to corrosion and erosion. **—K-93**

Steam Generators

A 20-page general catalog covering steam generators and allied equipment is announced by Erie City Iron Wks.

The bulletin provides cross section views of all major products to show design and construction. It is available as Catalog SB 60. **—K-94**

Double Suction Pumps

Bulletin 251 covering Type DMB and DB ball bearing, horizontal split case, double suction centrifugal pumps for general water service, has been published by Warren Pumps Inc. The bulletin includes detailed specifications, sectional view, selection table, and outline dimensions. **—K-95**

Water Chillers

A 16-page illustrated brochure, Bulletin 8325, describing the redesigned line of Type CD packaged water chillers for air conditioning and industrial cooling applications is now available from American-Standard, Industrial Div.

The new catalog outlines the advantages of the redesigned units and discusses and illustrates the outstanding mechanical specifications. A series of schematic wiring diagrams shows control panel wiring, control circuit wiring for city water operation, and cooling tower operation. Also illustrated are pneumatic control connections. **—K-96**

low air pressure can
SABOTAGE
your plant production

Curtis protects... against it!

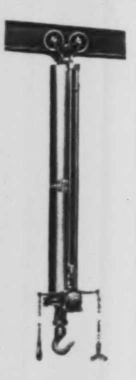
Air hammers, drills, sand blasts may be working... but are they working at peak efficiency? With the right Curtis compressor on the job, you can be sure of an adequate and dependable supply of compressed air at the proper pressure.

PRESSURE-UP YOUR TOOLS

The sealed, precision-built Curtis AIR COMPRESSOR delivers all the power your tools can use.

- Two-stage, air-cooled . . . 1 thru 50 H.P.
- Single-stage, air-cooled . . . ¼ thru 5 H.P.
- Timken bearings; pressure lubrication.

Tank-mounted compressors, ¼ thru 20 H.P. (1 to 95 cu. ft.).
Simple and base-mounted, ¼ thru 50 H.P. (1 to 217 cu. ft.).

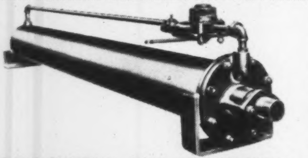


PENDANT AIR HOISTS

LIFT, LOWER... PUSH or PULL... UP TO 10 TONS

Movement smoother than human hands. Precise control. And precision Curtis manufacturing assures efficiency, long life; trouble-free operation.

C-65



BRACKETED AIR CYLINDERS
For horizontal or vertical mounting

Curtis
MANUFACTURING COMPANY
PNEUMATIC DIVISION
Write Dept. 44,
ST. LOUIS 20, MISSOURI

KEEP INFORMED

BUSINESS NOTES
NEW EQUIPMENT
LATEST CATALOGS

Pressure Transmitter

Bulletin WG-1824, Supplement A, issued by Yarnall-Waring Co., describes new differential pressure transmitter developed by the company.

The bulletin covers applications, operation, construction details, advantages, and operating specifications. **—K-97**

Gas-Air Burners

Selas Corp. of America has issued Bulletin PR-1, which presents an improved line of low-cost, precision-built gas-air burners said to combine positive flame geometry with maximum heat release and low turndown.

The bulletin describes how the burners provide a reducing neutral or oxidizing flame with any commercial fuel gas. It breaks up the flame front into a large number of small flames, resulting in a concentrated flat face round flame of high intensity. **—K-98**

Bar, Tube Machinery

Medart bar and tube machinery is described and illustrated in a new booklet, 2533-JJ58, available from Blaw-Knox Co.

The 18-page booklet covers billet peeling and chipping, centerless turning, bar and tube straightening, stretch straightening, wire straightening and cutting, and roll grinding. Twenty-eight pictures point up the advantages of the machinery. **—K-99**

Control Systems

B-I-F Industries, Inc. announces a bulletin No. 9480.20A describing its Proportioneers metering-type additive blender which automatically proportions liquid dyes, solvent oils and other petroleum additives to gasolines or fuel oil streams.

The two-page bulletin contains photographs of the system, line drawings of a typical hookup, descriptive text, design features, specifications and a chart depicting maximum recommended flows for viscous fluids. The Model EDB blender is the positive displacement reciprocating piston type. **—K-100**

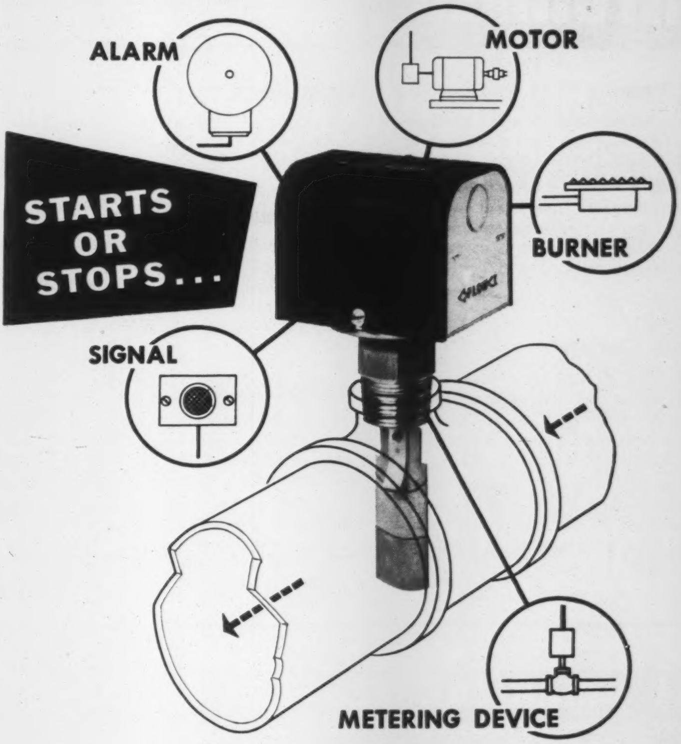
Worm Gear Reducers

Winsmith, Inc. has issued a 12-page illustrated catalog, No. HSDR-58, on its new double reduction hollow shaft worm gear speed reducers in both Series STD torque arm and Series SFD flange mounted types.

Each type is stocked in three sizes, covering an output range from 0.041 to 2.552 hp, a ratio range from 66-2/3 to 4466:1, and a maximum output torque range of 1380 to 7678 in-lb. The catalog contains all parts indexes, unit dimensions, dimensions for high speed and slow speed shaft bores, plans and elevations of all shaft arrangements, and tables of weights for both types. **—K-101**

Makes or breaks a circuit when flow STARTS . . . or STOPS

McDonnell FS4 Series Flow Switch



The illustration tells the story of the McDonnell FS4 Flow Switch. Installed in a pipe line, it is a moderately priced, highly dependable device that makes or breaks a circuit when flowing liquid moves the paddle—to perform almost endless functions vital to safety and automatic operation. Underwriters' Listed.

New Bulletin FS-1 fully covers all details of construction and service ranges. Also contains typical applications that may suggest important services the FS4 Flow Switch can perform in your plant.

McDONNEL & MILLER, Inc., 3510 N. Spaulding Ave., Chicago 18, Ill.

Doing One Thing Well

SAFETY CONTROLS REG. U. S. PAT. OFF.

McDONNELL

Flow Switches

Boiler Water Feeders • Low Water Fuel Cut-Offs
Pump Controllers ○ Relief Valves • Related Liquid
Controls for Tanks, Stills, Air Conditioning Systems

USE THIS COUPON to get your copy of new Bulletin FS-1

Please send me a copy of your new Bulletin FS-1

Company Name________________

Street Address________________

City Zone & State________________

By________________

Mail to: McDonnell & Miller, *Inc.*, 3510 N. Spaulding Ave., Chicago 18, Ill.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

O-Rings, Packings

A bulletin dealing with the design and application of O-rings has been published by Garlock Packing Co.

The 20-page booklet discusses materials of construction, dynamic and static applications, use of back-up or nonextrusion rings and groove design for this style of packing. It is designated Bulletin AD-148. **—K-102**

Instrument Bearings

The firm's line of thin-section ball bearings, made in precision and ultraprecision grades to dimensions of the AFBMA B-500 series, is described in a new 24-page catalog available from Split Ballbearing Div. MPB, Inc.

Known as the T series, the bearings feature an exclusive method of construction which makes possible a full ball complement without loading slots, plus integral shielding, and one-piece retainers for radial type bearings. **—K-103**

Waterspheres

A folder describing the advantages of water-spheres has been published by Chicago Bridge & Iron Co. **—K-104**

Transformer Vapor Cooling

Vapor cooling for transformers is discussed in an eight-page booklet by Westinghouse Electric Corp. Entitled "Vapor Cooling," the publication covers both principles and practice. It is designated No. B-7602. **—K-105**

Engineering Drawings

Four solutions to problems in reproducing engineering drawings are presented in a folder published by Peerless Photo Products, Inc.

The problems dealt with in the folder are copying drawings made on opaque paper, making prints from tracings that have been erased, reprinting in quantity, reproducing pencil tracings. **—K-106**

Hoists, Cranes

An eight-page folder, DH-28, illustrating motor-operated hoists, hand-operated hoists, jib cranes, hand-traveling cranes, and motor-driven cranes, has been made available by Wright Hoist Div. American Chain & Cable Co.

The bulletin contains data on general features, construction details, weights, dimensions, suspensions, specifications, clearances, accessibility of the units. **—K-107**

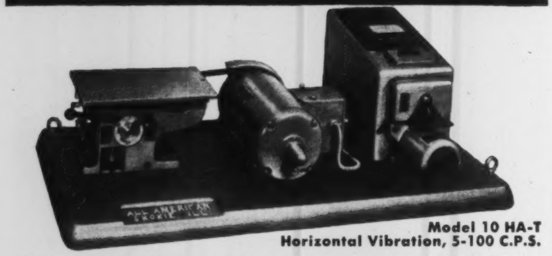
Data to A-C Motors

A new a-c motor selector booklet, Bulletin B-2103-4, giving selection data on motors from 1 through 200 hp, has been issued by Reliance Electric and Engineering Co.

Included in the 12-page booklet are brief explanations of NEMA design classes, speed-frequency relationship, current and torque values, frame selection tables and dimension information for standard frames and mechanical modifications for all frame sizes from 182 through 6085. **—K-108**

ALL AMERICAN TESTERS

SPOT VIBRATION WEAK SPOTS BEFORE COSTLY FAILURE!



Model 10 HA-T
Horizontal Vibration, 5-100 C.P.S.

• How much vibration will your product take? Where are the danger areas? All American Vibration Fatigue Testers answer these questions in your shop or laboratory with shake-down tests that simulate field service vibrations. Engineering gets the facts needed to improve design at lowest cost. Equally effective in spot-checking production runs.

• All American Testers meet U.S. Government specifications for horizontal or vertical vibration testing of all sizes and shapes of units weighing up to 150 lbs. Range Selector automatically controls acceleration and deceleration, or holds vibration frequency at any desired point between 5 and 100 cycles per second.

CATALOG "F"
gives full facts on all 10 All American Testers, proved in long service to government and industry.
Write for your free copy now.

ALL AMERICAN TOOL & MFG. CO.
Builders of ALL AMERICAN Precision Die Filing Machines
8019 Lawndale Avenue • Skokie, Illinois

HANOVER
GERMAN INDUSTRIES
FAIR
april 26-may 5, 1959
TO BE HELD IN HANOVER, WEST GERMANY
4,300 Export Manufacturers of Industrial and Consumer Goods

INDUSTRIAL: All types of Machinery*—Iron and Steel — Electrical Engineering — Optical — Precision Instruments — Atomic Energy — Aviation — Petroleum — Office Machines.

CONSUMER GOODS: China, Ceramics, Glass — Jewelry and Silverware — Watches and Clocks — Radio, TV and Phonograph Sets — Electrical Appliances.

*Textile Machinery will not be shown at 1959 Fair

For descriptive folders, admission passes, room reservations:

German-American Chamber of Commerce
350 Fifth Avenue, New York 1, N.Y.
Wisconsin 7-0727

Get positive piping protection with

ZALLEA NON-EQUALIZING EXPANSION JOINTS . . .

Zallea Non-Equalizing Corrugated Expansion Joints offer a degree of protection that can't be equalled for absorbing movement of piping due to temperature changes. They protect interconnected equipment by absorbing movements in otherwise rigid piping systems. They are used in low pressure and vacuum lines . . . between stills, tanks, columns, condensers, pumps and similar equipment.

Standard Sizes: 3″ to 72″ dia.; Special sizes to 50 ft. dia. Pressures: Vacuum to 50 psig. Temperatures: to 1600°F.

Special Applications. With the addition of proper components, Zallea Non-Equalizing Expansion Joints can be used as:

Universal Expansion Joints to absorb movement in any direction . . . axially, laterally, angularly, or any combination of these.

Pressure Balanced Expansion Joints to absorb axial movement outside the unit and still carry pressure thrust.

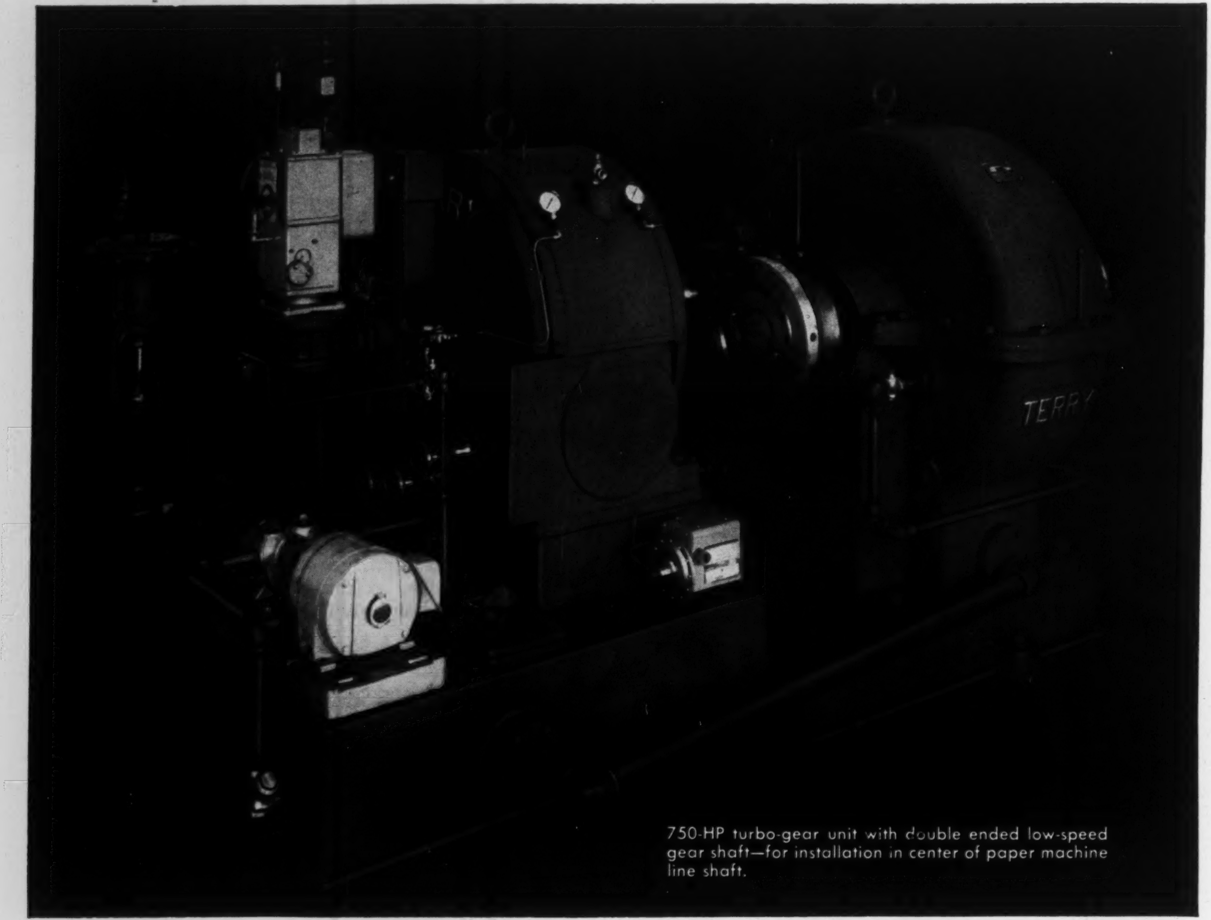
Hinged and Gimbal Expansion Joints for piping systems that cannot be anchored in the conventional manner.

Get the complete story of Zallea Expansion Joints in our new 72-page manual. They are available for any pressure condition to 3600 psig. Write, on your company letterhead, for your copy of Catalog 56.

Zallea
expansion joints

Zallea Brothers • Wilmington 99, Delaware
World's largest manufacturers of expansion joints

Large Zallea Non-Equalizing Expansion Joint installed on deaerating heater of Ford Motor Company's River Rouge plant.



750-HP turbo-gear unit with double ended low-speed gear shaft—for installation in center of paper machine line shaft.

LOW-SPEED TURBINE DRIVES

tailored to meet your requirements

For more than half a century, Terry has been one of the principal suppliers of turbo-gear units for driving slow-speed fans, generators, paper machines, large pumps and the like. Each unit is designed to meet the job requirements. The paper-machine drive illustrated is a good example of this *individualized engineering.*

In service at a large southeastern paper mill, the unit delivers 750 HP at 3350/500 RPM, with steam conditions of 450 lbs., 660°F and 50 lbs. back pressure. Equipped with a variable-speed governor, operated by remote control, the speed of the unit may be varied through a 10:1 range. Other features include forced-feed lubrication to turbine and gear bearings, and automatic shutdown and alarm in case of low oil pressure.

Whatever *your* requirements for low-speed turbine drives, a Terry engineer will be pleased to discuss them with you. Bulletin S-140 covers the full line of Terry turbines; Terry gears are described in bulletin S-130.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1212

Robertshaw sets the pace with

CAPTIVE SEAL® VALVES

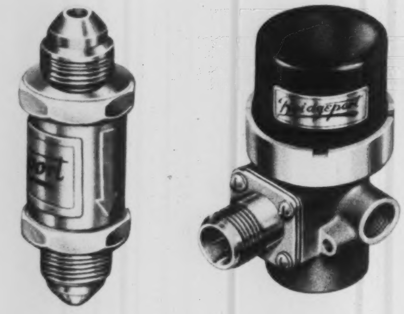
The smallest, lightest valves, per given flow capacity, ever produced! An exclusive sealing principle makes these valves your best guarantee of meeting space-age specifications and performance requirements.

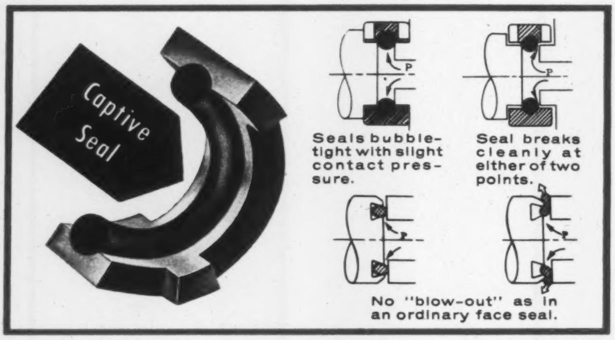
over

Robertshaw sets the pace with

CAPTIVE SEAL VALVES

. . . utilizing an exclusive sealing principle!




Captive Seal
P
P
Seals bubble-tight with slight contact pressure.
Seal breaks cleanly at either of two points.
No "blow-out" as in an ordinary face seal.

These advanced design valves offer greater flow capacity per size and weight than any other valves available today. For example:

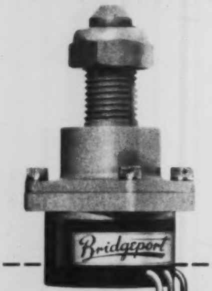
Type	Flow Capacity (equiv. orif. dia.)	Flow Factor $\Delta P = N(GPM)^2$	Weight (lbs.)	Length (inches)
SOLENOID	.103	27	.45	1.625
CHECK	.09	47	.033	2.02
PRESSURE ACTUATED	.132	10	.20	2.66

Robertshaw Captive Seal Valves are designed for rapid response, lower power consumption and high pressure service up to 3000 psig. They are direct-acting, balanced valves requiring far less actuating force in hydraulic and pneumatic systems. Many types and variations available . . . all with valve components proved in the field.

The Captive Seal principle makes use of a patented steel retainer concept certified for rated pressure condition. Even abrasive particles in the fluid or air stream can't damage the Captive Seal. For additional data on full line, which also includes pilot, trigger and pressure relief models, write for Catalog 40!

Robertshaw MINIATURE PRESSURE SWITCHES

. . . unaffected by vibration and temperature cycling!



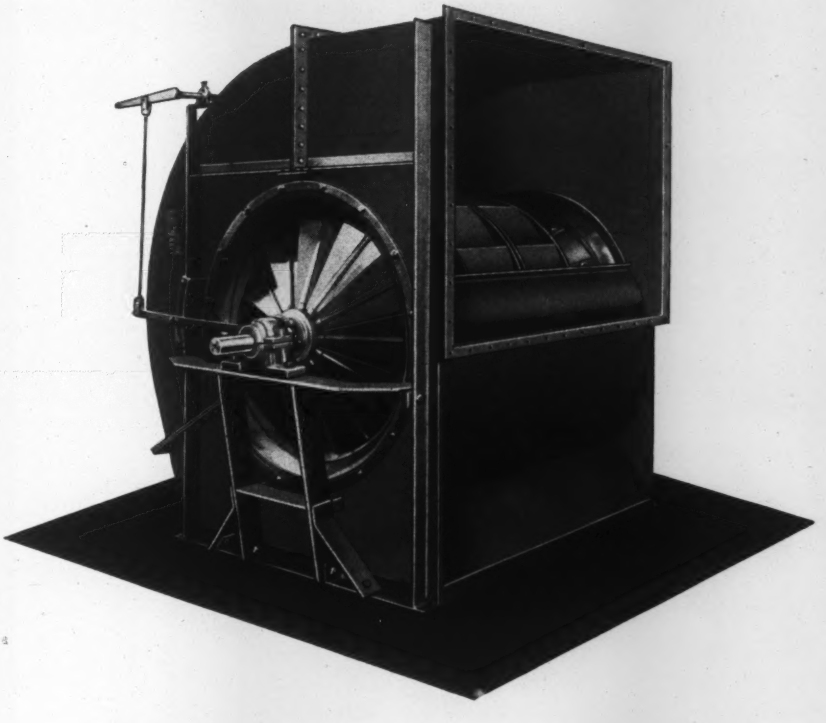
Small . . . light . . . rugged pressure switches for aircraft, rocket and missile applications. Built to withstand vibration up to 2000 cps ±10 g's in any direction. Pressure settings range from 10 to 3000 psig. Ambient temperature range is from −65° F to ±250° F. And their minimum life is a rugged 20,000 cycles. Robertshaw bulkhead-mounting pressure switches are so compact they can be grouped on 1.09″ centers. The lightest weighs less than 3 ounces. Switch headings are encapsulated in epoxy resin to assure constant switch settings and repeatability. Widely used to handle combustion gases, fuel, oil, H_2O_2, helium, etc. Write for Bulletin 20!

Robertshaw-Fulton
CONTROLS COMPANY

BRIDGEPORT THERMOSTAT DIVISION • Milford, Connecticut

CLARAGE

Presenting new highs in quietness
and dependable broad efficiency...



NEW DYNAFOIL heavy-duty FAN

featuring a perfected airfoil blade design

With this new Clarage Type AF Dynafoil Fan you get stable high efficiency where it counts—under actual operating conditions. Ideally suited to mechanical draft and heavy-duty applications, such as industrial processes, conduit type air conditioning, and tunnel ventilation, this latest in the Clarage line of superior fan equipment is built in 13 sizes, Classes II, III, and IV construction.

WRITE FOR CATALOG 859 which provides outlined dimensions and description of new Clarage Type AF Dynafoil Fans. Or contact nearest office.

CLARAGE
Dynafoil Fans

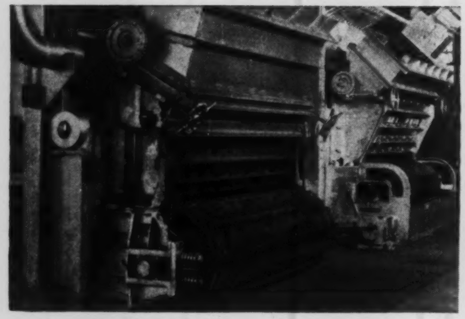
Dependable equipment for making air your servant

CLARAGE FAN COMPANY

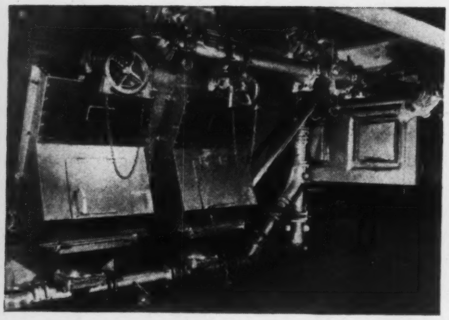
Kalamazoo, Michigan

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

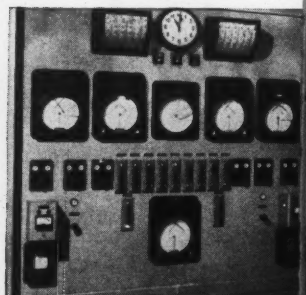
New 450 HP LW-80—world's largest coal hauler—is 12' high by 12' wide, 54½' long. It hauls 100 cubic yards (80 tons) per trip at speeds up to 34 mph.



View in the LeTourneau-Westinghouse boiler plant. In foreground is an Erie City 40,000 lb/hr type I.W.T. boiler, used on stand-by basis and for peak loads in very cold weather. At the right rear is Erie City 60,000 lb/hr main boiler. Both are fired by Combustion Engineering Inc. traveling grate stokers.



Shown are ash hoppers, part of United Conveyor ash handling system. Ashes are dumped from ash pits into hoppers from where they are piped pneumatically to silo. This system also handles dust from Prat-Daniel dust collectors.



Bailey Control Panel includes boiler meters & recorders, feedwater controllers and alarms, drum level recorders and alarms, gages for draft control.

From pit to plant, LeTourneau-Westinghouse moves with coal

Earthmoving equipment manufacturer estimates steam generated from coal costs only half as much as from competitive fuels

At LeTourneau-Westinghouse Co., Peoria, Ill., steam is used to heat an area that has swelled to a million square feet of space. Increasing demand created the need for a modern boiler plant to replace obsolete equipment. When plans were drawn for the new plant, fuel surveys indicated that the firm should continue to use coal for availability and economy. Estimates showed that steam produced from burning coal in this area costs about *half as much* as from competitive fuels.

Today LeTourneau-Westinghouse has found that burning coal in modern equipment cuts costs in several ways. Fuel costs, of course, are at a minimum. Automatic, efficient operation has lowered coal and ash handling costs. And manpower requirements have been reduced from 12 to 7 men.

Coal is lowest cost fuel

Today, *when the annual cost of fuel often equals the original cost of the boilers,* you should know that bituminous coal is the lowest cost fuel in most industrial areas. And modern coal-burning equipment gives you 15% to 50% more steam per dollar, while automatic operation trims labor costs and eliminates smoke problems. What's more, tremendous coal reserves and mechanized mining procedures assure you a constantly plentiful supply of coal at stable prices.

Technical advisory service

To help you with fuel problems, the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to address below or send coupon. Ask also for case histories booklet, complete with data sheets. You'll find them informative.

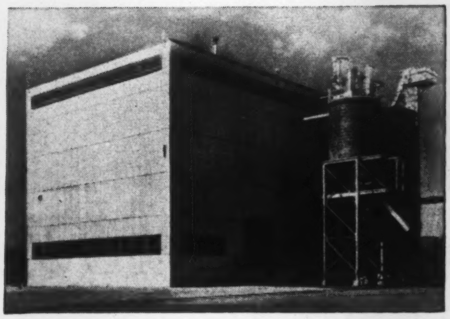
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you with the efficiency and economy of coal.

BITUMINOUS COAL INSTITUTE

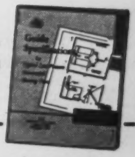
Department ME-03, Southern Building, Washington 5, D. C.

See our listing in *Sweet's*



New heating plant showing 9000 cu. ft. Kalamazoo Tank & Silo Co. coal silo (on right). Coal moves by conveyor from track hopper to top of silo. Entire coal handling system by Beaumont Birch Co. To left of coal silo is Kalamazoo 25-ton ash silo equipped with United Conveyor dustless rotary unloader.

SEND COUPON FOR NEW BCI PUBLICATIONS. Guide Specifications, with complete equipment criteria and boiler room plans:



Bituminous Coal Institute, Southern Building, Washington 5, D. C.

Gentlemen: Please send me: **ME-03**

☐ GS-1 (low-pressure heating plant, screw-type underfeed stoker); ☐ GS-2 (high-pressure heating and/or process plant, ram-type underfeed stoker); ☐ GS-3 (automatic package boiler for heating and process plants). ☐ Case histories on larger plants.

Name

Title

Company

Address

City Zone State

HELP US KEEP THE THINGS WORTH KEEPING

It doesn't take much to remind you of why you want peace. You know it in your heart every time you look at your daughter. You know we *must* keep the peace.

But knowing isn't enough. It takes *doing*. Fortunately there is something you can do.

Peace costs money. Money for strength to keep the peace. Money for science and education to help make peace lasting. And money saved by individuals to help keep our economy strong.

Your Savings Bonds, as a direct investment in your country, make you a Partner in strengthening America's Peace Power.

The chart below shows how the Bonds you buy will earn money for you. But the most important thing they earn is peace. They help us keep the things worth keeping.

Think it over. Are you buying as many as you *might?*

HOW YOU CAN REACH YOUR SAVINGS GOAL WITH SERIES E SAVINGS BONDS

(in just 8 years, 11 months)

If you want about	$2,500	$5,000	$10,000
each week save	$4.75	$9.50	$18.75

500
200
100
50
50
SERIES E

HELP STRENGTHEN AMERICA'S PEACE POWER

BUY U. S. SAVINGS BONDS

The U.S. Government does not pay for this advertising. The Treasury Department thanks The Advertising Council and this magazine for their patriotic donation.

ADVERTISING COUNCIL PUBLIC SERVICE

BEYOND THE RIM

Today mankind is embarked on the most exciting voyage of discovery since Columbus sailed beyond the rim of the known world.

In a physical sense, it is a voyage that ranges from investigation of the infinitesimal components of matter to exploration of the vastness of the cosmos.

But at Sandia Laboratory it is a voyage of the mind—a voyage beyond the rim of our present comprehensions, to unlimited destinations.

At our laboratories in Albuquerque, N. M. and Livermore, California, we perform research and development pertaining to nuclear weapons and certain allied non-military projects for the Atomic Energy Commission. We need men with the knowledge, the experience, and the desire to venture beyond the rim in many fields of science and engineering. At present, we have challenging opportunities in these specific fields:

PHYSICS and MATHEMATICS—Scientists at PhD level for both fundamental and applied research. Both physicists and mathematicians are needed at our Albuquerque location, mathematicians only at Livermore.

EXPLOSIVES CHEMISTRY—Chemists or chemical engineers with advanced degrees and extensive experience in this field, at both Albuquerque and Livermore.

STATISTICS—Experienced statisticians with MS or PhD degrees and interest in statistical methods and quality control, particularly in statistical design of experiments. Required at Albuquerque only.

QUALITY CONTROL—Industrial, mechanical, and electrical engineers with experience in quality control methods development and training assignments, at Albuquerque only.

STRESS ANALYSIS—Experienced mechanical or aeronautical engineers, preferably with advanced degrees, at both Albuquerque and Livermore.

HUMAN ENGINEERING—Experienced personnel with advanced degrees in psychology plus engineering degrees, at Albuquerque only.

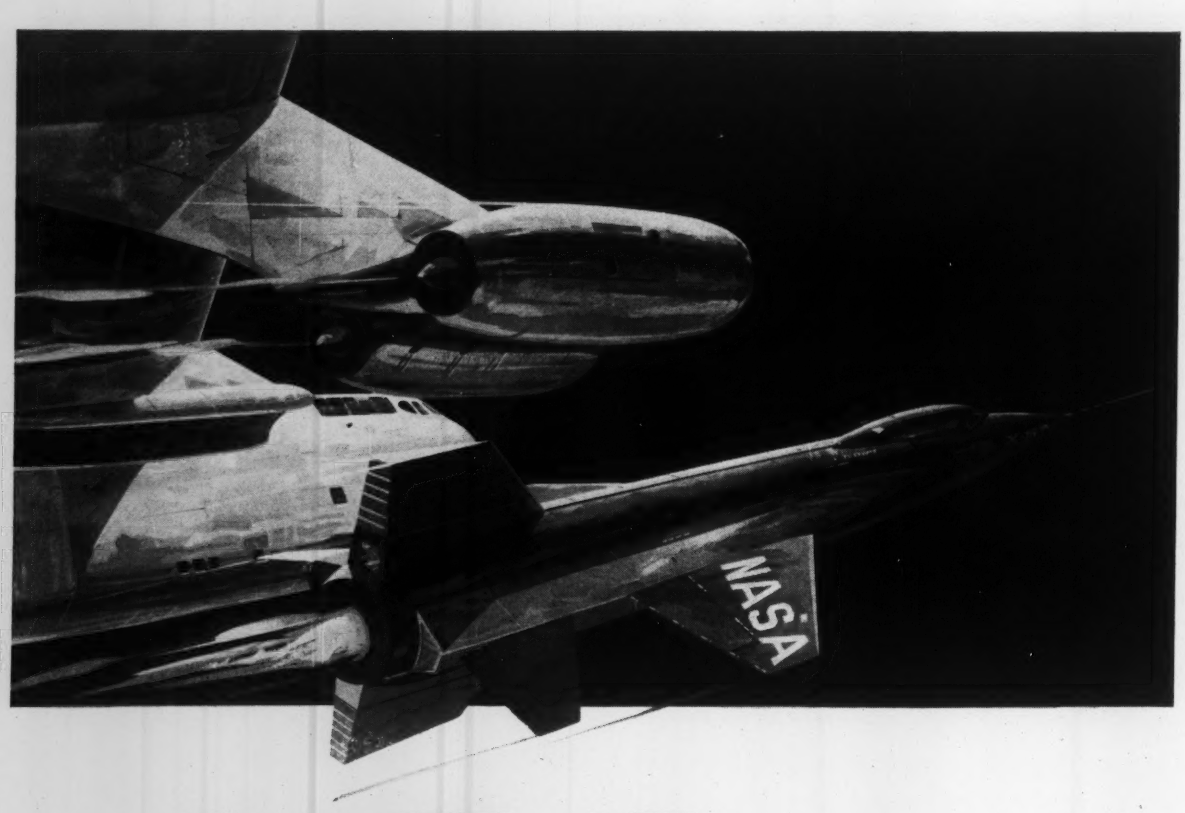
HEAT TRANSFER—Aeronautical or mechanical engineers with MS or PhD degrees for analytical and experimental research and development in aerodynamic heating and heat transfer problems, at Albuquerque only.

ELECTRICAL or MECHANICAL ENGINEERING—experienced personnel with BS or MS degrees, at both Albuquerque and Livermore.

Sandia Laboratory offers many advanced and specialized facilities to further work of its scientists and engineers. Liberal employee benefits, including generous vacations and holidays, insurance and retirement plans, educational aid program, add to Sandia's attractiveness as a place to work. Albuquerque, a city of over 225,000 with a mild, dry climate and friendly Southwestern atmosphere, is a delightful place in which to live. Livermore, located in the San Francisco Bay area, offers suburban advantages close to metropolitan San Francisco.

IF YOU ARE INTERESTED in a career at Sandia, our illustrated brochure will tell you more about the opportunities we offer to advanced scientists and engineers. Write to Employment Section 553E at either Albuquerque, N. M., or Livermore, California.

SANDIA
CORPORATION
ALBUQUERQUE, NEW MEXICO



the X-15

The 1-mile-per-second X-15, designed to carry its pilot into the fringes of space, is a product of joint efforts of NASA, Air Force and Navy, with close cooperation of North American Aviation, Reaction Motors and 300 other contracting firms. This aircraft —latest in a long-term program conceived by NASA scientists for the advanced study of the problems of flight—will make its first flights soon. NASA has technical direction of the X-15 project and will report the research results for use by Government and industry.

The X-15 is a *rocket research airplane*, a flying laboratory.

Primary research interest in the X-15 is to obtain knowledge of actual flight conditions in the near space environment, to produce a wealth of information from repeated missions involving entry into and exit from the atmosphere. And *only man* can prove how man will react in space to weightlessness and intense acceleration and deceleration.

The X-15 program is typical of the exciting things happening at NASA, whose responsibility it is to direct and implement U. S. research efforts in aeronautics and the exploration of space, for peaceful purposes and the benefit of all mankind.

NASA offers unique opportunities in basic and applied research in aeronautics and space technology—

For Engineers:
Aeronautical, Engineering Physics, Electronic, Mechanical, Electrical, Metallurgical, Chemical, Civil.

For Scientists:
Astronomers, Physicists, Mathematicians, Chemists, Metallurgists.

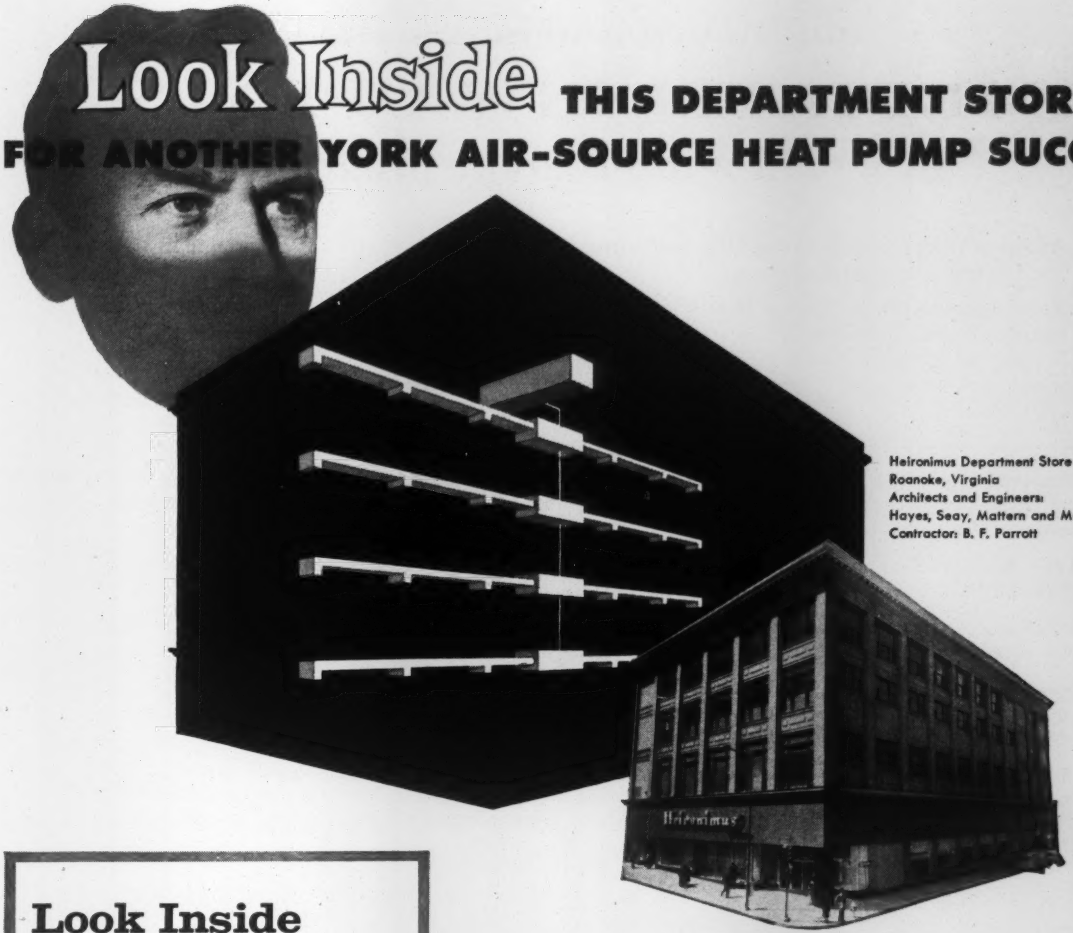
Please address your inquiry to the Personnel Director of any of the following NASA research centers:

- **Langley Research Center,**
  Hampton, Virginia
- **Ames Research Center,**
  Mountain View, California
- **Lewis Research Center,**
  Cleveland, Ohio
- **High-Speed Flight Station,**
  Edwards, California
- **Beltsville Space Center**
  4555 Overlook Ave., Washington, D.C.

(Positions are filled in accordance with Aeronautical Research Announcement 61B)

NASA National Aeronautics and Space Administration

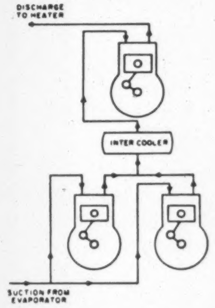
Look Inside THIS DEPARTMENT STORE FOR ANOTHER YORK AIR-SOURCE HEAT PUMP SUCCESS



Heironimus Department Store
Roanoke, Virginia
Architects and Engineers:
Hayes, Seay, Mattern and Mattern
Contractor: B. F. Parrott

Look Inside

York's Exclusive Compound-Compression Design for up to 67% Greater Efficiency



Compound compression of refrigerant in a series of cylinders yields 67% more heat for a given displacement than conventional single-stage unparallel cylinders.

312 Tons of Refrigeration Cooling ...2,450,000 Btu's/hour for Heating

And it's all made possible by YORK's patented compound-compression design. Delivers more Btu's per watt than conventional systems using only outside air and incoming power lines. No coal, gas, oil or supplementary heaters required...even in areas having winter design temperatures of –10° F and lower.

More than two years ago, Heironimus Department Store in Roanoke, Virginia became the first building in this country to be equipped with YORK's new air-source Heat Pump. Operating costs have proved considerably less than previously possible with separate heating and cooling systems.

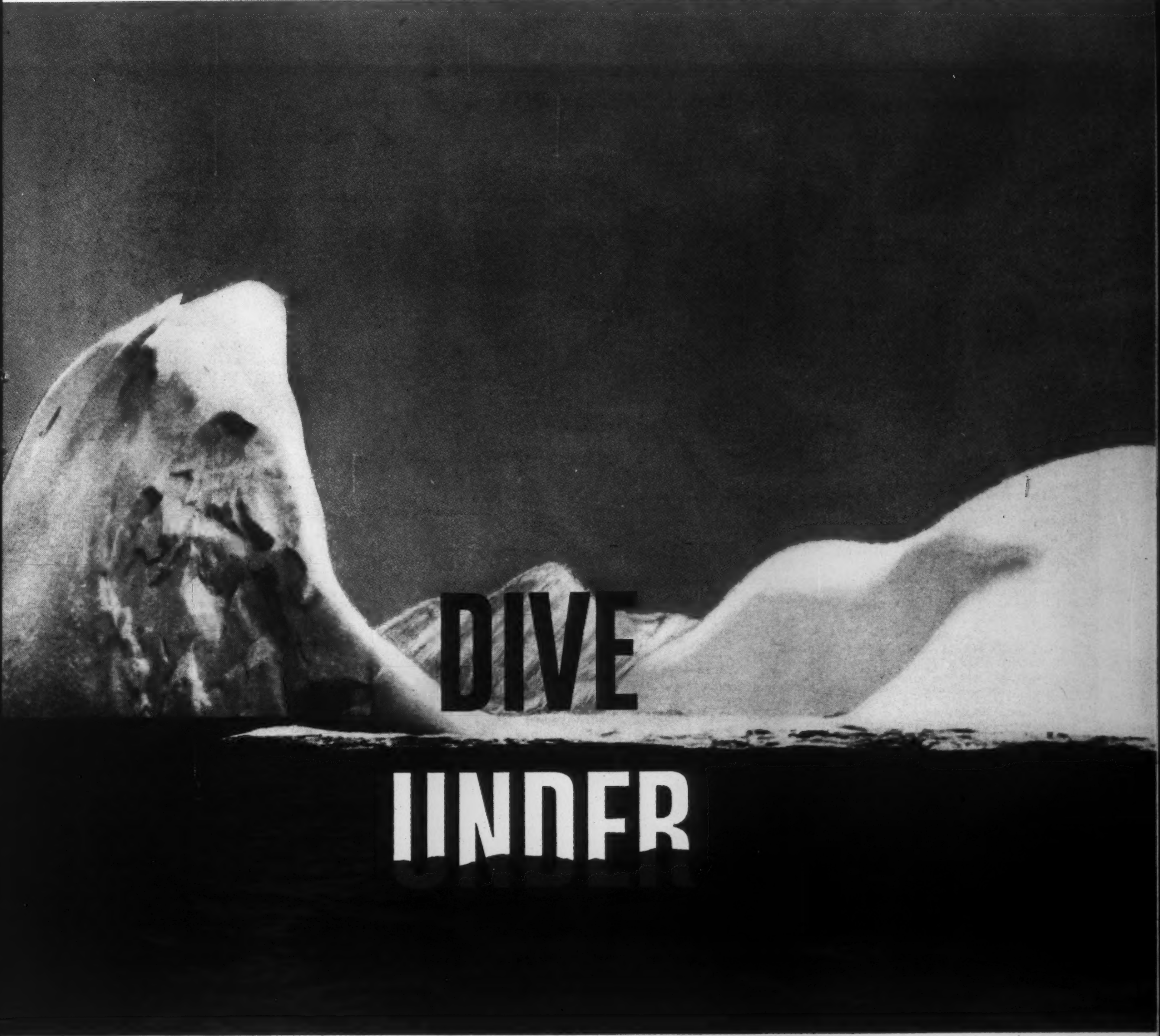
Since that time, more YORK Central Station Heat Pumps have been specified than those of all other manufacturers.

YORK

YORK CORP. SUBSIDIARY OF BORG-WARNER CORP.

BORG-WARNER
RESEARCH & ENGINEERING
MAKE IT BETTER

Air Conditioning, Heating, Refrigeration and Ice Equipment • Products for Home, Commercial and Industrial Installations



—then take a deep breath

It's easy with the air purification systems of the U. S. S. Nautilus, Seawolf and Skate — equipped with reliable Air Preheater rotary heat-exchangers.

Ships designed to be more efficient under water than on the surface—even under the polar ice cap—must have an *absolutely dependable* source of fresh air. On the nuclear subs, an ingenious system designed by Desomatic Products, Inc. purifies the air by passing it through a catalyst chamber.

But the air must be hot—650° F.—for the catalyst to work. So an Air Preheater rotary heat exchanger provides over 85% of the necessary temperature boost — increases incoming air temperature to 575° F. Consequently, an electric heater of only 6KW capacity is needed to reach catalyzing temperature. (Without the Air Preheater exchanger, a 40KW heater would be necesary.) And the rotary Air Preheater cuts air conditioning requirements, too, by recovering over 500° F. from the purified air leaving the catalyst chamber.

Designed for durability, the compact 11" x 20" exchanger has stainless steel heating elements; and the carbon-graphite seal will resist temperatures up to 1000° F.

This Air Preheater rotary heat exchanger is only one of a variety available for marine and industrial installation. Let us know your requirements, and we'll be glad to show you how Air Preheater can help you.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

engineers and scientists

IMMEDIATE NEW OPENINGS

in world wide reactor programs

Atomics International is rapidly expanding its atomic power reactor program in both the United States and overseas.

This expansion has created the following career opportunities at AI's headquarters in Canoga Park, California:

ENGINEERING ANALYSIS

Reactor Engineering. Analysis and design of over-all power reactor systems and components. Prefer power reactor background in engineering design and analysis. Experience in reactor safeguard analysis also valuable.

Core Analysis. Complete nuclear analysis to include criticality, flux distribution, and reactivity requirements. Fuel cycle economics and optimization.

Shielding. Analysis and design of biological and thermal shielding of large stationary power plants. Advanced studies and methods analysis for compact and mobile power plants.

Heat Transfer and Fluid Flow. Steady state and transient experimentation and analysis. Power optimization studies; free and forced convection flow transients; boiling and two phase flow in water, organic and liquid metal systems.

Structures. Transient and steady state stress analysis of reactor components subjected to mechanical loads, thermal cycling, and thermal shock. Advanced analytical studies in thermal stress fatigue, elastic and inelastic behavior of plates and shells, structural dynamics, and electronic analogue and digital computer application.

FUEL ELEMENT DEVELOPMENT

Fuel Materials. Senior Physical Metallurgists and Chemists for research and development of reactor fuels. Research in gas-metal systems, emphasis on structural, phase equilibria, and material properties.

Alloy development of fuel and cladding materials for operation in power reactors up to temperatures of 1200°F. and higher.

Study radiation effects, over-all evaluation of uranium and alloys and ceramics.

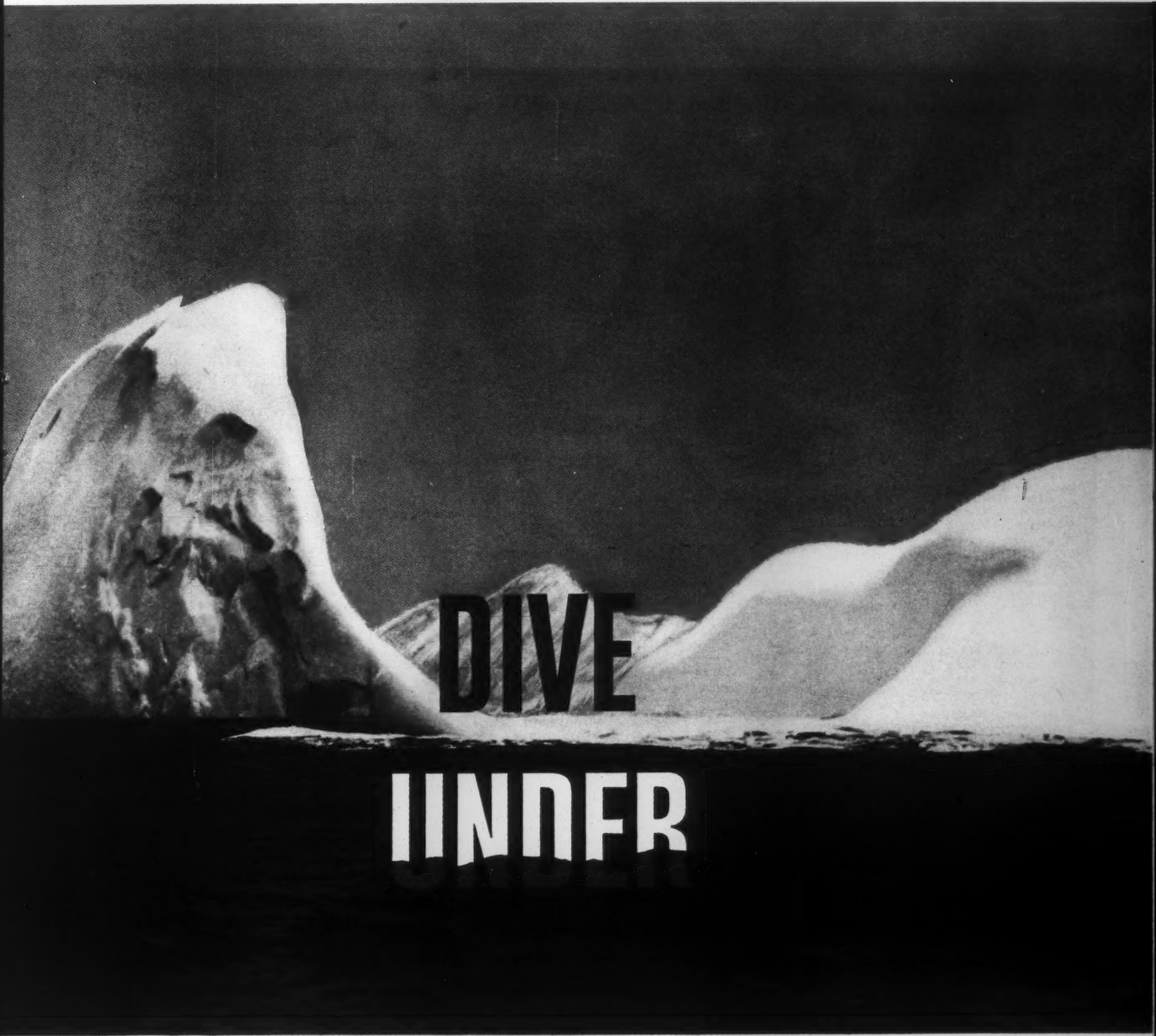
Fuel Fabrication. Senior Metallurgical, Mechanical and Chemical Engineers for fabrication development of materials and elements. Includes both rod-type and plate-type elements and complex assemblies. Development of non-destructive tests for these elements.

Irradiation Experiments and Hot Lab Evaluation. Senior Physicists, Chemists and Engineers to develop and conduct irradiation experiments to establish the behavior of fuel materials and prototype fuel elements under conditions of temperature and radiation anticipated in full scale power reactors. Also Senior personnel to develop techniques and equipment for the post-irradiation testing and evaluation of these experiments.

Write today for more details about exciting career opportunities at A.I.

Mr. A. C. Newton, Personnel Office, Atomics International
21600 Vanowen Street, Canoga Park, California
(In the suburban San Fernando Valley, near Los Angeles)

ATOMICS INTERNATIONAL
A DIVISION OF NORTH AMERICAN AVIATION, INC.



—then take a deep breath

It's easy with the air purification systems of the U. S. S. Nautilus, Seawolf and Skate — equipped with reliable Air Preheater rotary heat-exchangers.

Ships designed to be more efficient under water than on the surface—even under the polar ice cap—must have an *absolutely dependable* source of fresh air. On the nuclear subs, an ingenious system designed by Desomatic Products, Inc. purifies the air by passing it through a catalyst chamber.

But the air must be hot—650° F.—for the catalyst to work. So an Air Preheater rotary heat exchanger provides over 85% of the necessary temperature boost – increases incoming air temperature to 575° F. Consequently, an electric heater of only 6KW capacity is needed to reach catalyzing temperature. (Without the Air Preheater exchanger, a 40KW heater would be necesary.) And the rotary Air Preheater cuts air conditioning requirements, too, by recovering over 500° F. from the purified air leaving the catalyst chamber.

Designed for durability, the compact 11" x 20" exchanger has stainless steel heating elements; and the carbon-graphite seal will resist temperatures up to 1000° F.

This Air Preheater rotary heat exchanger is only one of a variety available for marine and industrial installation. Let us know your requirements, and we'll be glad to show you how Air Preheater can help you.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

Here are the AMERICAN STANDARDS *to consult—*
for approved dimensions, permissible tolerances, and other specifications
covering SMALL TOOLS AND MACHINE TOOL ELEMENTS

ACCURACY OF ENGINE AND TOOL ROOM LATHES, B5.16—1952. $1.00
Gives the tolerances to which industry is building 12 in. to 18 in., 20 in. to 32 in., and 40 in. to 72 in. lathes and the tests for determining the accuracy of the lathes.

CHUCKS AND CHUCK JAWS, B5.8—1954. $1.50
Establishes controlling dimensions for all chucks from 6-in. to 36-in. diameter of both medium and heavy duty types, for an extra heavy series of chucks with serrated master jaws, for power-operated and hand-operated chucks of two-, three-, and four-jaw types.

CIRCULAR AND DOVETAILED FORMING TOOL BLANKS, B5.7—1954. $1.50
In this standard are the sizes and types of tool blanks and the associated mounting portions of their respective holders for use on 60 types of automatic screw machines, the latter being classified in the Standard into six different groups of comparable stock capacities. Tolerances and screw threads are specified. Typical blanks and holders are illustrated.

DRILL DRIVERS (Split-Sleeve, Collet-Type), B5.27—1951. $1 00
This Standard gives taper dimensions, general specifications, and the dimensions for 135 sizes of drill drivers along with the standard and optional taper number for each size.

DRIVING AND SPINDLE ENDS FOR PORTABLE AIR TOOLS, B5.38—1958 $1.50
This Standard applies to portable power tools for drilling, grinding, polishing, sawing, and driving threaded fasteners. It includes dimensions and tolerances for both driving and driven elements where such coordination is important and not established by reference to the pertinent American Standards.

INSERTED BLADE MILLING CUTTER BODIES. B5.23—1958 $1.50
Here are given the dimensions and dimensional tolerances of cutter bodies for: shell end mills; half side mills; staggered-tooth side mills; face mills—flat back series; face mills—series 50. Sizes are limited to a range of from 3 to 24 in. in diameter.

INVOLUTE SPLINES, B5.15—1950. $3.00
Tables give dimensional and effective clearances, minor diameter fits, dimensions for both the flat root and fillet root types, basic measurements between and over pins, special pin measurements, and hob and broach dimensions. Provisions are made for allowable errors. Formulas are given for calculating pin measurements and torque capacities.

INVOLUTE SERRATIONS, B5.26—1950. $2.00
In this Standard are the tooth dimensions, the basic dimensions from which the dimensions for any serration may be calculated, tolerances for a complete gaging system, basic measurements between and over pins, formulas for calculating space width and tooth thicknesses, recommended hob dimensions, and provisions for allowable deviations.

INVOLUTE SPLINE AND SERRATION GAGES AND GAGING, B5.31—1953. $1.50
Factors affecting fits and their control, working and inspection gages, inspection methods, machining tolerances and allowable errors are among the subjects covered.

JIG BUSHINGS, B5.6—1941. (Reaffirmed 1949) $1.00
Dimensions for: Press-Fit Wearing, Renewable-Wearing and Liner Bushings.

KNURLING, B5.30—1958 $1.50
This Standard specifies dimensional relationship between knurl tool and stock, and gives standard diametral pitches for tools. Data on tooth depths for diagonal knurls have been added to the 1958 Standard.

MACHINE MOUNTING SPECIFICATIONS FOR ABRASIVE DISCS AND PLATE MOUNTED WHEELS, B5.35—1957. $1.50
Establishes standards for location and size of bolt holes in steel discs wheels (machine face plates) and the mounting side of abrasive discs and plate mounted wheels. Twenty-seven illustrations supplement the text.

MOUNTING DIMENSIONS OF LUBRICATING AND COOLANT PUMPS FOR MACHINE TOOLS, B5.28—1958. $1.00
Tables give specific mounting dimensions for motor-driven centrifugal pumps, centrifugal and geared pumps, centrifugal pumps (flange mounted type), gear and vane pumps, and for mounting brackets.

PUNCH AND DIE SETS FOR TWO-POST PUNCH PRESS TOOLS, B5.25—1950. $1.50
These dimensions for back-post and diagonal-post sets cover die area ,the die holder and punch holder thickness, shank diameter and lengths, guideposts and bushings, and removable punch holder shanks.

ROTATING AIR CYLINDERS AND ADAPTERS, B5.5—1954. $.100
Tables in this Standard show dimensions of air cylinders having 3, 4½, and 6 to 20 in. bore, the dimensions of adapters, sizes of adapter screws and tapped holes; and pull and stress data at 100 lb per sq in. air pressure.

CARBIDE BLANKS AND CUTTING TOOLS, B5.36—1957. $2.00
Presents the standard sizes, styles, designations, dimensions and tolerances of carbide blanks, sintered carbide tipped general purpose tools, sintered carbide boring tools, solid sintered carbide inserts 1½" and longer and their holders. The recommended identification system for each group is given.

SINGLE-POINT TOOLS AND TOOL POSTS, B5.22—1950. $2.00
Standard defines and illustrates the different classes of tools ,their parts ,and the angles at which they are used. Dimensions include those for: tool shanks ,tool post openings, and lathe center height for solid tools and tool holders, six styles of sintered carbide tips, and the tips and shanks of tipped tools.

MARKINGS FOR IDENTIFYING GRINDING WHEELS AND OTHER BONDED ABRASIVES, B5.17—1958. $1.00
Covering markings only, this Standard establishes a symbol for each of the most essential characteristics of a grinding wheel and arranges them in uniform sequence. The grinding wheels and other bonded abrasives to which this standard applies are: Segments, bricks, sticks, hones, rubs, other shapes which are used to remove material, alter shape or size, produce a desired surface or accuracy of dimension, or a combination of these objectives.

SPINDLE NOSES FOR TOOL ROOM LATHES, ENGINE LATHES, TURRET LATHES, AND AUTOMATIC LATHES, B5.9—1954. $2.50
Presents dimensions of each size and type of nose; of mating backs of chucks, face plates and fixtures, and of gages for checking their important dimensions. Permissible tolerances are specified. Spindle noses (types A, B, D and L) are described and recommendations given for their use on different types of lathes.

SPINDLE NOSES AND ADJUSTABLE ADAPTERS FOR MULTIPLE SPINDLE DRILLING HEADS B5.11—1954. $1.00
Here are the general dimensions of assembly and the detail dimensions of adjustable adapter body, set screw slot, adjustable extension adapters, adjustable adapter set screw and friction lock nuts, and spindle noses. Tolerances, finish and marking are specified.

SPINDLE NOSES AND ARBORS FOR MILLING MACHINES, B5.18—1953. $1.00
Contains dimensions for ends of arbor and adapter, for spindle nose, and for draw-in bolt end; also sketches of selective types of drive key construction.

20% Discount to ASME Members

STRAIGHT CUT-OFF BLADES FOR LATHES AND SCREW MACHINES, B5.21—1949. $1.00
Gives dimensions for the height, length, and thickness of the approved four types of blades, and includes sketches to show the optional shapes for cut-off blade stock.

T-SLOTS, THEIR BOLTS, NUTS, TONGUES, AND CUTTERS, B5.1—1949. $1.50
Tables show dimensions for T-slots, their tongues and cutters; and for inserted and reversible tongues and tongue seats. Tolerances are specified.

LIFE TESTS OF SINGLE-POINT TOOLS, B5.19—1946. (Reaffirmed 1953) $1.00
Shows how to evaluate performance of single-point tools made of material other than sintered carbides.

LIFE TESTS FOR SINGLE-POINT TOOLS OF SINTERED CARBIDE, B5.34—1956. $1.00
Recommendations apply to the tool shape, the preparation of the tools for tests, and the methods of testing to determine relationship between tool wear and cutting time.

TWIST DRILLS, B5.12—1958. $2.00
This Standard gives nomenclature, definitions, sizes and tolerances of two flute straight and taper shank drills; also similar information for combined drills and countersinks, plain and bell type. It also includes selected sizes of millimeter drills; screw machining length drills; jobbers and taper length in place of short and longer lengths given in the 1950 Standard; and an appendix listing drills by decimal size.

DESIGNATION AND WORKING RANGES OF GRINDING MACHINES, B5.32 and 33—1953. $1.00
Data and information supplied by this Standard apply to all sizes of reciprocating table surface grinders having horizontal spindles and to all swings of plain cylindrical grinding machines up to and including 36 in. size.

MACHINE TAPERS, B5.10—1953. $1.50
Presents basic dimensions for 22 sizes of self-holding tapers; detailed dimensions and tolerances for self-holding taper shanks and sockets. for the plug and ring gages applying to this series of tapers; and the dimensions for 12 sizes of steep machine tapers.

MACHINE PINS, B5.20—1958. $1.50
These dimensions are for hardened and ground dowel pins, straight pins, ground dowel pins (not hardened), taper pins, clevis pins, and cotter pins. An appendix gives drilling specifications for taper pins and a drill chart for the size of drill and number required.

MILLING CUTTERS, B5.3—1950. $3.00
Reflecting the developments in cutter design, tool material, and machine improvements are the 56 illustrated types for which dimensions are here given.

REAMERS, B5.14—1949. $2.00
General dimensions of thirty standard types of reamers and related tools are presented along with the magnitude and direction of the tolerances including the number of flutes in the various types.

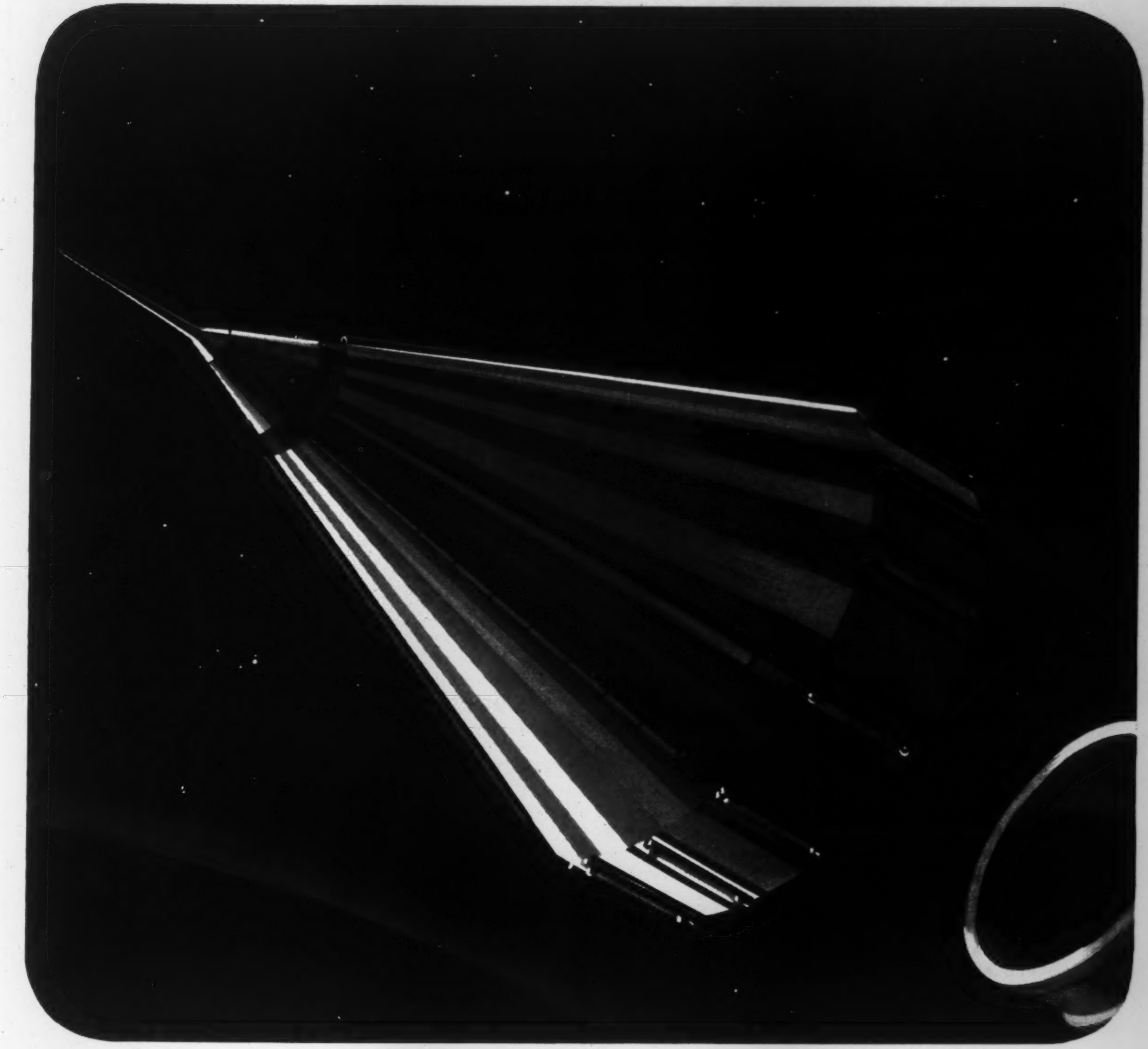
TAPS—CUT AND GROUND THREADS, B5.4—1948. $2.00
32 tables gives the thread and general dimensions together with the working tolerances for nine types of taps. Supplementary material includes terminology and definitions; and instructions for making taps, dies, and other threading tools.

BINDERS

A specially designed binder for holding these Standards is available. It is 9" × 12" in size and provided with flexible steel rods which can be slipped out of or under the top and bottom metal lips. It gives every advantage of a bound book together with the added convenience which comes from the ability to instantly insert, remove or transpose sections of the contents. **Price, $3.25**

Published by **THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39 ST., N. Y. 18**

NOTABLE ACHIEVEMENTS AT JPL . . .



PIONEERING IN SPACE RESEARCH

Another important advance in man's knowledge of outer space was provided by Pioneer III. This, like many others of a continuing series of space probes, was designed and launched by Jet Propulsion Laboratory for the National Aeronautics and Space Administration. JPL is administered by the California Institute of Technology for NASA.

During its flight of 38 hours, Pioneer III was tracked by JPL tracking stations for 25 hours, the maximum time it was above the horizon for these stations.

The primary scientific experiment was the measurement of the radiation environment at distances far from the Earth and telemetering data of fundamental scientific value was recorded for 22 hours. Analysis of this data revealed, at 10,000 miles from the Earth, the existence of a belt of high radiation intensity greater than that observed by the Explorer satellites.

This discovery is of vital importance as it poses new problems affecting the dispatch of future vehicles into space. The study and solution of such problems compose a large part of the research and development programs now in extensive operation at the Laboratory.

jpl

CALIFORNIA INSTITUTE OF TECHNOLOGY
JET PROPULSION LABORATORY
A Research Facility operated for the National Aeronautics and Space Administration
PASADENA, CALIFORNIA

OPPORTUNITIES NOW OPEN IN THESE CLASSIFICATIONS ▶ APPLIED MATHEMATICIANS . ENGINEERING PHYSICISTS . COMPUTER ANALYSTS . IBM-704 PROGRAMMERS
AERONAUTICAL ENGINEERS . RESEARCH ANALYSTS . DESIGN ENGINEERS . STRUCTURES AND DEVELOPMENT ENGINEERS

HAGAN NEWSLETTER

Behind the Panel

AUTOMATIC DATA LOGGING FOR NATION'S FOURTH LARGEST WATER SYSTEM

A 158-year-old water works system, taking the first step toward full automation, is installing telemetering and micro-wave facilities to feed data from 92 remote locations throughout their 12 water districts to a Hagan Kybernetes Data Handling system installed in a central building—the Load Control Center. The data includes such items as: water levels, river elevations, pumping rates, pumping pressures, water flow, and other information to provide an operator at the Load Control Center with an instantaneous picture of events throughout the whole water works system.

High and low limits for every point can be fixed from the central system and such off-normal conditions as unexpected level changes, distribution pressure drop, rise in river height will be detected by visible and audible alarms from the Kybernetes system, as well as red printing on the log sheets where the data system is recording all the variables. Normal operation calls for print-out every hour, but it may be obtained at any time—as well as printing special continuous readings on any point experiencing off-normal conditions. Hagan also furnished the main control console and a graphic wall panel. (Item B-1)

HIGH EFFICIENCY DUST COLLECTOR PAYS FOR ITSELF IN TWO WEEKS

Uranium dust in the atmosphere at a uranium ore reduction plant had become an irritating air pollution problem—as well as a source of loss of the valuable ore dust. A Hagan Aerostatic Dust Collector was installed at the rod mill in the plant and has been operating at 97.7% efficiency—recovering so much uranium dust that it paid for itself in two weeks. The collector has shown no signs of wear or tube plugging. In fact, one plant official said, "This is the first mechanical collector I have ever come across that is actually self-cleaning." At another installation where blast furnace slag dust is being collected, the Hagan unit was inspected after 15 months' service. More than 160 tons of abrasive dust had passed through the tube that was cut in half for examination, yet no wear was visible. In fact, most of the mill scale was still intact. (Item B-2)

METER ACCURACY TEST . . . 1 + 1 + 1 + 1 = 1

The odd looking formula above refers to a utility installation where Hagan Ring Balance meters are in service for all principal metering. The first four figures represent four Ring Balance meters which measure these flows: 6th extraction stage, 9th extraction stage, 12th extraction stage and condensate. A fifth meter measures steam flow to the turbine. In other words, the fifth meter measures steam before the turbine while the totals of the other four meters represent steam recovered after the turbine. Ideally, these totals would be the same. At the end of a nine month period the sum of the four meters was compared to the total recorded on the fifth and the figures were within 2.4% of each other, despite the fact that more than three-quarters of a billion pounds of steam had passed through the system over this period. (Item B-3)

SUPER-SONIC MISSILE TESTS IN LESS THAN 30 SECONDS

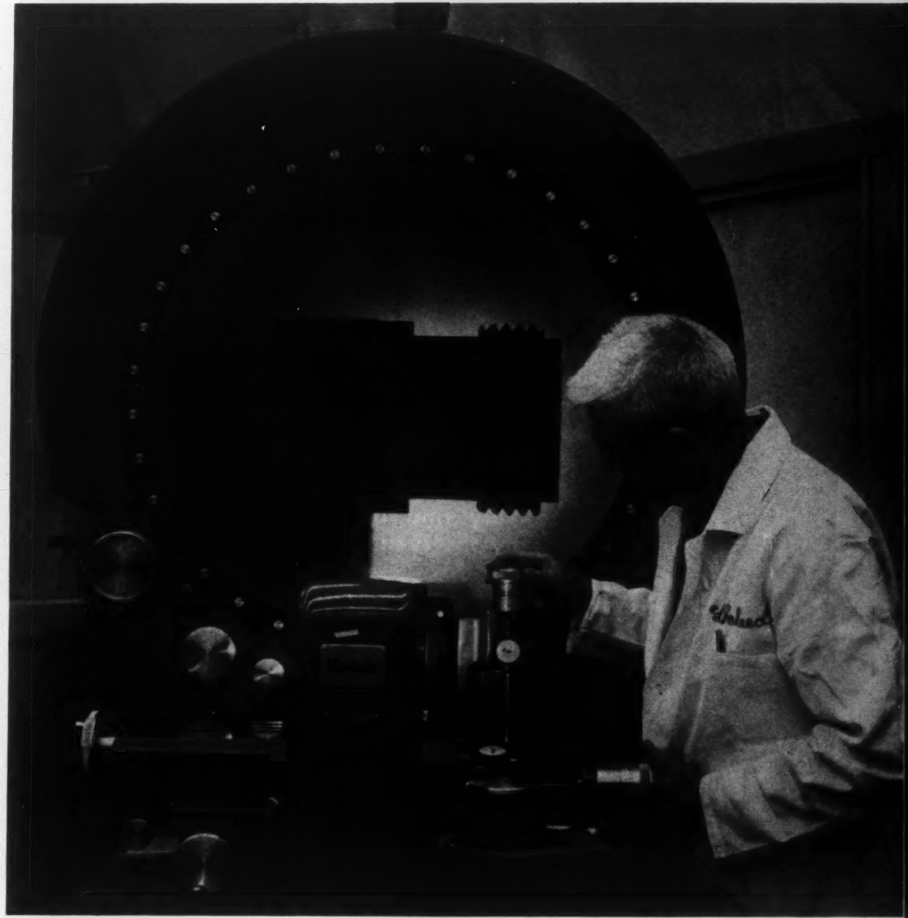
Snap a huge valve open in a fraction of a second—let a 3000 mph gale blow through for a few seconds—keep this supersonic hurricane constant in a test chamber—all this in less than 30 seconds. Next, volumes of data from brief tests like this are analyzed to know, in advance, if your missile or aircraft is ready for flight. This is what happens in a blowdown wind tunnel where Hagan PowrAmp control systems meet and exceed rigid specifications for split-second accuracy and reliability. At one blowdown tunnel where PowrAmp transducers, amplifiers, computers, electro-hydraulic pilot valves and operators are installed at critical control points, the tunnel was "blown in" for its first test without aid from Hagan engineers, who were available, but were not needed after the PowrAmp equipment had been installed and adjusted. (Item B-4)

HAGAN CHEMICALS & CONTROLS, INC.

Hagan Building, Room 701, Pittsburgh 30, Pa.

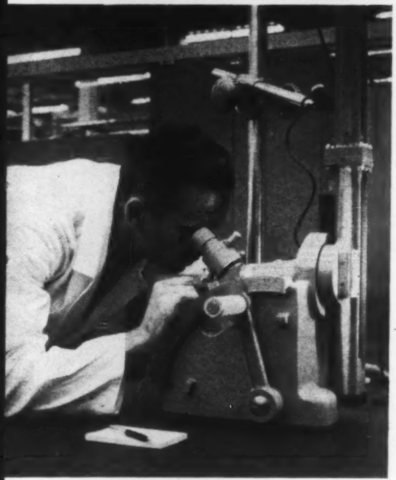
If you would like more information on any of the above items, check the appropriate box below.

☐ Item B-1 ☐ Item B-2 ☐ Item B-3 ☐ Item B-4



(*right*) Checking accuracy of machine threads on a 30 inch magnification contour projector.

Nation's first successful re-entry tests were conducted with Lockheed X-17.



Optical gauge determines measurements within 5 millionths of an inch.

QUALITY ASSURANCE

Expanding the Frontiers of Space Technology

Quality assurance at Lockheed parallels in importance and augments the research and development, projects, and manufacturing organizations. Quality assurance engineers establish audit points, determine functional test gear, write procedures, and perform related tests.

These activities, supported by laboratories, data analysis, establishment of standards, and issuance of reports – all insure that Lockheed products meet or surpass contractual requirements. Economy and quality are maintained at every stage to produce the best products at the least cost.

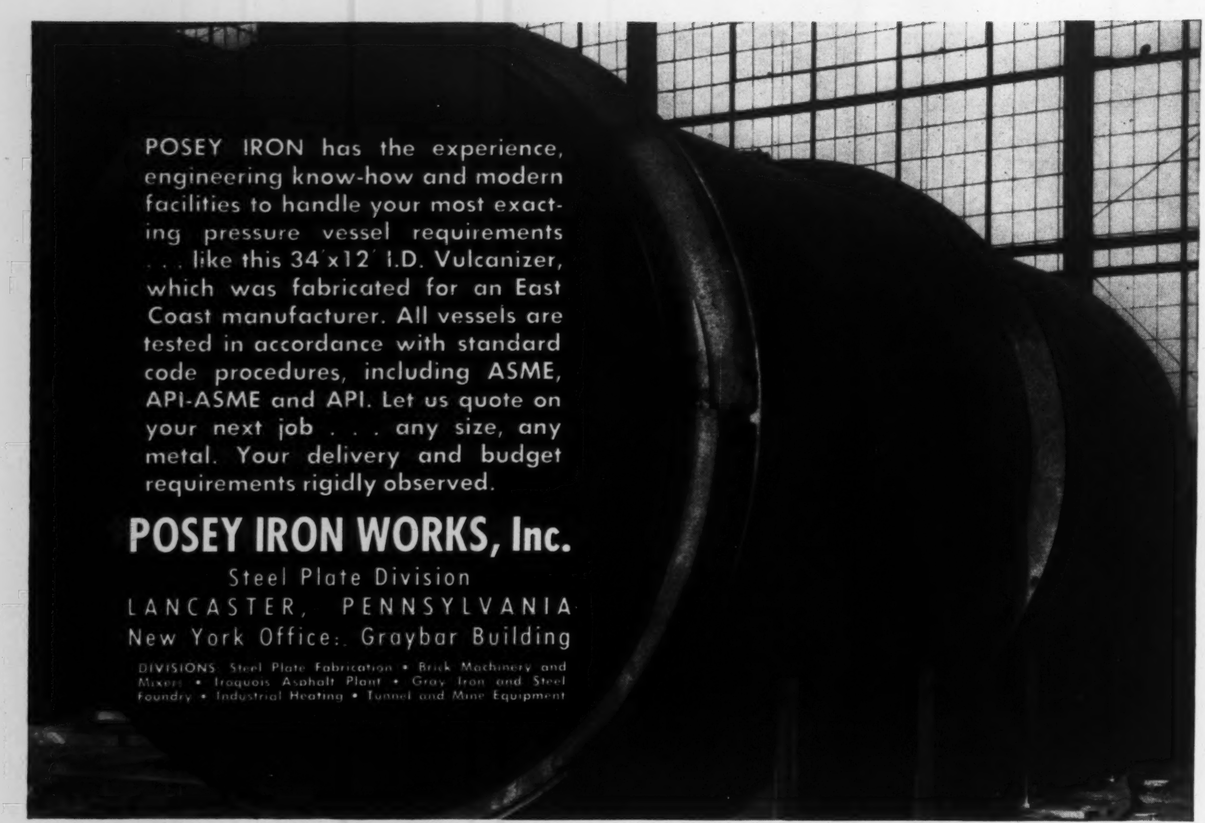
With the company holding such major, long-term projects as the Navy Polaris IRBM; Army Kingfisher; and Air Force Q-5 and X-7, quality assurance at Lockheed plays a key role in the nation's defense.

Scientists and engineers of outstanding talent and inquiring mind are invited to join us in the country's most interesting and challenging basic research and development programs. Write: Research and Development Staff, Dept. C-40,
962 W. El Camino Real, Sunnyvale, California.

"The organization that contributed most in the past year to the advancement of the art of missiles and astronautics." NATIONAL MISSILE INDUSTRY CONFERENCE AWARD

Lockheed / **MISSILES AND SPACE DIVISION**

SUNNYVALE, PALO ALTO, VAN NUYS, SANTA CRUZ, SANTA MARIA, CALIFORNIA • CAPE CANAVERAL, FLORIDA • ALAMOGORDO, NEW MEXICO



POSEY IRON has the experience, engineering know-how and modern facilities to handle your most exacting pressure vessel requirements . . . like this 34′x12′ I.D. Vulcanizer, which was fabricated for an East Coast manufacturer. All vessels are tested in accordance with standard code procedures, including ASME, API-ASME and API. Let us quote on your next job . . . any size, any metal. Your delivery and budget requirements rigidly observed.

POSEY IRON WORKS, Inc.

Steel Plate Division
LANCASTER, PENNSYLVANIA
New York Office: Graybar Building

DIVISIONS: Steel Plate Fabrication • Brick Machinery and Mixers • Iroquois Asphalt Plant • Gray Iron and Steel Foundry • Industrial Heating • Tunnel and Mine Equipment

---

SOUTHWEST "Monoball"® SELF-ALIGNING BEARINGS

PLAIN TYPES
ROD END TYPES
EXT.
INT.
PATENTED U. S. A.
World Rights Reserved

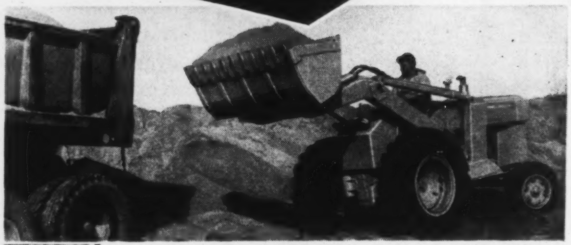
CHARACTERISTICS

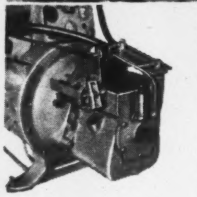
	ANALYSIS	RECOMMENDED USE
1	Stainless Steel Ball and Race	For types operating under high temperature (800-1200 degrees F.).
2	Chrome Alloy Steel Ball and Race	For types operating under high radial ultimate loads (3000-893,000 lbs.).
3	Bronze Race and Chrome Steel Ball	For types operating under normal loads with minimum friction requirements.

Thousands in use. Backed by years of service life. Wide variety of Plain Types in bore sizes 3/16″ to 6″ Dia. Rod end types in similar size range with externally or internally threaded shanks. Our Engineers welcome an opportunity of studying individual requirements and prescribing a type or types which will serve under your demanding conditions. Southwest can design special types to fit individual specifications. As a result of thorough study of different operating conditions, various steel alloys have been used to meet specific needs. Write for Engineering Manual No. 551. Address Dept. ME-59.

SOUTHWEST PRODUCTS CO.
1705 SO. MOUNTAIN AVE., MONROVIA, CALIFORNIA

FUNK LICKED THIS 3-WAY PROBLEM





On this Massey-Ferguson Work Bull Multi-Purpose Loader, a FUNK-designed REVERS-O-MATIC DRIVE permits triple operation with one pedal. Instantly changes the speed and direction of travel, leaves hands free for other operations and provides neutral speed control.

And a FUNK TORQUE CONVERTER automatically adjusts power between speed and load requirements.

Just one example of how FUNK MODULAR POWER UNITS can be combined in an unlimited number of arrangements — *without* special engineering costs.

Let FUNK find the solution to *your* power transmission problem.

FUNK MFG. CO.
Box 577-E
Coffeyville,
Kansas

COST
GOV'T
$3500.00

SPECIAL ELECTRIC VARIABLE SPEED HYDRAULIC TRANSMISSION

An electric, reversible variable speed transmission. Use where remote or automatically controlled variable speed drive is needed. . . on Lathes, Band Saws, Conveyors, etc. As a Torque Amplifier it will operate a Boat Rudder, Robot Manipulators, etc. As a Servo Motor it will operate large Valves, Ventilators, etc. Each unit is complete with a variable displacement hydraulic pump and motor – both integrally mounted inside oil reservoir. Electric motor is 5/8 HP, 220 V, 60 cycle, 3-phase, 3425 RPM. Remote unit has an electric differential Selsyn motor. Lowest gear reduction is 24 to 1 giving tremendous torque through a 1" output shaft. Delivers 435 inch lbs. of torque at 50 RPM. Also available with a 3/4 HP, 3425 RPM, single phase electric motor at the same prices.

MANUAL CONTROL 138^{88} REMOTE CONTROL 148^{88}

ELECTRIC HYD. MOTOR PUMP

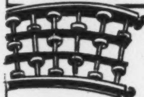
AS LOW AS $115

Motor designed to face mount any Aircraft type Hydraulic Pump. Made to meet the most rigid requirements of industry. For continuous duty with a high starting torque. Available in 115/230 V, 1 phase or 220/440 V, 3 phase – 60 cycle AC. Sizes from 3/4 to 15 HP. Pressures up to 3000 PSI. Write for Cat. H-59 for complete information and other Bargains.

21 TO 1 SPEED REDUCER

Precision built for Army Gun Control Mechanism. Gear ratio gives approx. 90 RPM with direct drive 1750 RPM motor. Can be belt driven with up to 1/2 HP motor. Has ball bearings throughout. Will operate conveyors, timing devices, etc. 21 to 1 gear ratio. 14^{75}

NOTE: Many other gear Bargains in stock. Write for Catalog Supplement H-59.



GRAVITY CONVEYOR

Has 500 lb. per ft. capacity. 12" wide curved steel frame with guard rail. 5 rows of 2" dia., 5/8" face ball bearing steel wheels. Unit is 45° ACR on 35" center line radius. Each unit couples to next at ends. Unused, excellent condition. 14^{95} EA.

HYDRAULIC REMOTE CONTROL MASTER & SLAVE

When connected with 1/4" tubing these units act as a precision, remote power transmission unit. Moving master handle causes the slave arm to respond in exact ratio to the master. Ideal for remote machinery controls.

Both units (used) No. H-EX-1SU 27.50

SAVE up to 85% on HYDRAULIC Valves, Pumps, Cylinders, Motors, etc.
We have the Largest On-the-shelf stocks in the country. Write for Cat. H-59

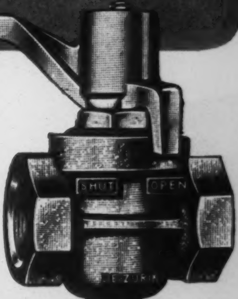
Palley's

Pay by M.O. or Check. P.O.'s accptd. from D&B firms
½ dep. with C.O.D.s Prices F.O.B. Los Angeles.
2263 E. Vernon Ave., Dept. ME-39, Los Angeles, Calif

THE TREND IN DRAFTING ROOMS THROUGHOUT THE WORLD IS TOWARD IMPERIAL, THE WORLD'S FINEST TRACING CLOTH

LEAK RATE*

less than .01 micron cfh thru the stem seal . . . less than .003 micron cfh seat leakage!



DeZurik Vacuum Valves

LONG, MAINTENANCE-FREE SERVICE LIFE

EXTREMELY LOW LEAK RATE

STRAIGHT-THRU FLOW for LOW IMPEDANCE

LOW INITIAL COST

The special requirements of high vacuum service are completely fulfilled with the DeZurik Vacuum Valve.

Their simple, positive quarter-turn action assures longer service life with less maintenance. Their straight-thru flow guarantees high conductance and low impedance. And their low cost permits savings without affecting performance.

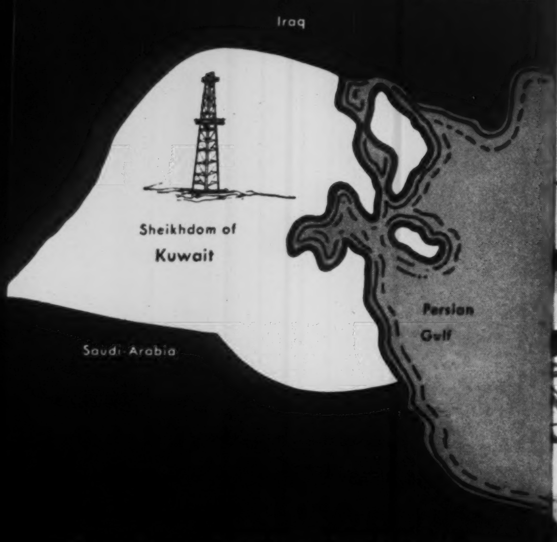
Used on high vacuum, air release, or throttling service, DeZurik Valves provide unique advantages for almost *any* vacuum service.

*This test on a 3" DeZurik Valve. All DeZurik Vacuum Valves are tested before shipment on a Helium mass spectrometer type leak detector.

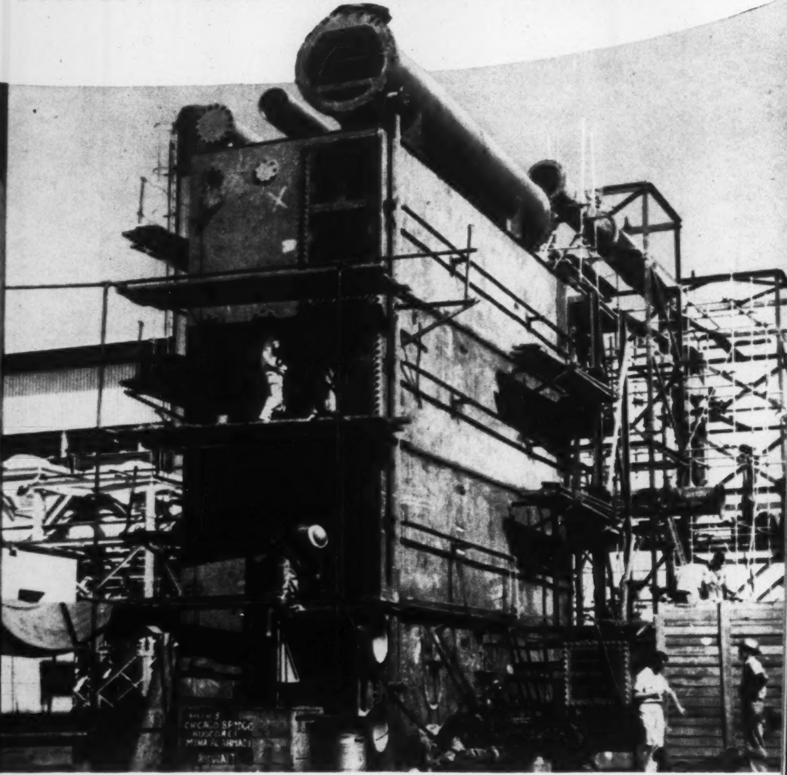
Available in sizes ½" thru 20" for manual or remote operation. See the DeZurik representative near you or write for details.

DeZURIK CORPORATION
SARTELL, MINNESOTA

CB&I—built Evaporators Convert World's Saltiest Sea Water



Persian Gulf Sheikhdom Quenches Centuries of Thirst



At the tip of the Persian Gulf, between Iraq and Saudi Arabia lies the Sheikhdom of Kuwait, blessed with seven percent of the world's oil and, until recently, plagued with some of the world's most *brackish* drinking water.

Once thirsty Kuwait has now solved its age-old problem. A CB&I-built "flash" evaporation system, designed by Westinghouse, now helps to convert Persian Gulf water—the world's saltiest, with 42,000 parts of dissolved solids per million gallons—into a fresh, potable liquid containing less than 100 parts dissolved solids per million gallons.

The overall system handles 5,000,000 gallons of fresh water daily for the capital city. Conversion is made at a rate of more than three pounds of drinking water *for each pound* of steam consumed.

An unusual installation? Yes, but typical of the world-wide background of experience with which CB&I steel plate specialists can meet the *most specific* customer requirements. This same *craftsmanship in steel* is available to you.

Write your nearest CB&I office for further details on the Kuwait Story and for the brochure: *CB&I Special Plate Structures.*

Above right

● One of two 4-stage flash evaporators built by CB&I and erected by Chicago Bridge Limited, London for Westinghouse International Corporation. "Flash" system replaces "shell and tube" unit—occupies 25 percent less space, handles double the capacity of fresh water.

C47CB

Chicago Bridge & Iron Company

Atlanta • Birmingham • Boston • Chicago • Cleveland • Detroit • Houston • Kansas City (Mo.)
New Orleans • New York • Philadelphia • Pittsburgh • Salt Lake City
San Francisco • Seattle • South Pasadena • Tulsa
Plants in Birmingham • Chicago • Salt Lake City • Greenville, Pa. • New Castle, Delaware
SUBSIDIARIES:
Horton Steel Works Limited, Toronto; Chicago Bridge & Iron Company Ltd., Caracas;
Chicago Bridge Limited, London; Chicago Bridge Construcoes Ltda., Rio de Janeiro
REPRESENTATIVES AND LICENSEES:
Australia, Cuba, England, France, Germany, Italy, Japan, Netherlands, Scotland

OPPORTUNITIES

positions open • positions wanted • equipment, material, patents, books, instruments, etc. wanted and for sale • representatives • sales agencies • business for sale • partnership • capital • manufacturing facilities

ANSWERS to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

RATES: Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $4.00 a line. $2.00 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display advertisements carried in single column units of multiples of one inch at flat rate of $40.00 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

POSITIONS OPEN

MECHANICAL ENGINEER

Major Foreign Operating Oil Company offers career opportunity for graduate mechanical engineer. Initial assignment in our New York office.

To Conduct equipment evaluation, technical service on mechanical equipment used in oil refineries and cross country pipelines, pressure vessel designing, etc.

Salary commensurate with experience. Write outlining personal history and work experience—please include telephone number.

Address CA-6618, care of "Mechanical Engineering."

NEW OPENINGS FOR ENGINEERS

Attractive opportunities available for mechanical or chemical engineers in engineering department of a multi-unit petro-chemical plant. Location—Tuscola, Ill.

PROJECT ENGINEERS—for design and construction, plant and equipment lay-out, estimating, plant maintenance.

MECHANICAL EQUIPMENT ENGINEER—for design, application and maintenance of pumps, compressors, blowers, turbines, etc.

MATERIALS HANDLING ENGINEER—for design and application of liquid and solid materials handling systems, unit containers, and packaging equipment.

Applicants should have 3 to 10 years' previous experience in chemical, refinery or process industry.

Submit resumes to Professional Employment Manager,

U.S.I. CHEMICAL DIVISION

NATIONAL DISTILLERS and CHEMICAL CORP.

99 PARK AVE. NEW YORK 16, N. Y.

Use a CLASSIFIED ADVERTISEMENT
For QUICK RESULTS

PLASTICS ENGINEER

MECHANICAL OR CHEMICAL ENGINEER to grow in challenging career in Plastics Department of leading buildings and capital equipment manufacturer. Process engineering duties involving development and modification of equipment and manufacturing methods used in formation of fiber-reinforced plastic products.

Requires degree in mechanical or chemical engineering, plus versatility, creativtiy and high degree of mechanical ability to do responsible production engineering work. Experience since graduation with dies and equipment used in manufacture of plastics desirable.

Position offers individual professional recognition, merit advancement, capable training in current product and manufacturing knowledge, excellent group comprehensive and other insurance benefits, company-paid retirement program, and an association in a forward-looking company with growing business for over 55 years.

Send full particulars in confidential letter to Orval W. Groves, Employment Supervisor, at address shown below.

BUTLER MANUFACTURING COMPANY

7400 East 13th Street
Kansas City 26 Missouri

ENGINEER — PACKAGE HANDLING

For Chicago area conveyor manufacturer, Ability to design systems and work with sales and estimating departments. Give full employment experience, education and salary desired.

Address CA-6626, % "Mechanical Engineering."

MB SEEKS ENGINEERS

- **Electronic**
- **Loudspeaker**
- **Mechanical**
- **Acoustic**
- **Hydraulic**
- **Dynamics**
- **Vibration**

For its new product program. World's largest producer of dynamic testing equipment is expanding its scope and offers exciting opportunities for engineers. For further information call or write J. M. Wirtz, Personnel Manager, MB Manufacturing Company, A Division of Textron Inc., P. O. Box 1825, New Haven 8, Conn. In New Haven, call FUlton 9-1511. In New York, call CAnal 6-4246.

SENIOR MECHANICAL ENGINEERS

Stromberg-Carlson, the electronics arm of General Dynamics Corporation, has immediate openings for several outstanding ME's with the experience listed below. The work is on advanced electronic projects in both the military and commercial fields.

1. *Senior Mechanical Engineer with broad experience in electronic packaging—mechanisms, heat transfer and shock & vibration.*
2. *Transducer Engineer with background in acoustics (especially electromechanical transducer design), dynamics of structures and properties of materials.*
3. *Hydraulic Engineer with broad mechanical engineering background in the application of hydraulic power and special knowledge of hydraulic servo valve design.*

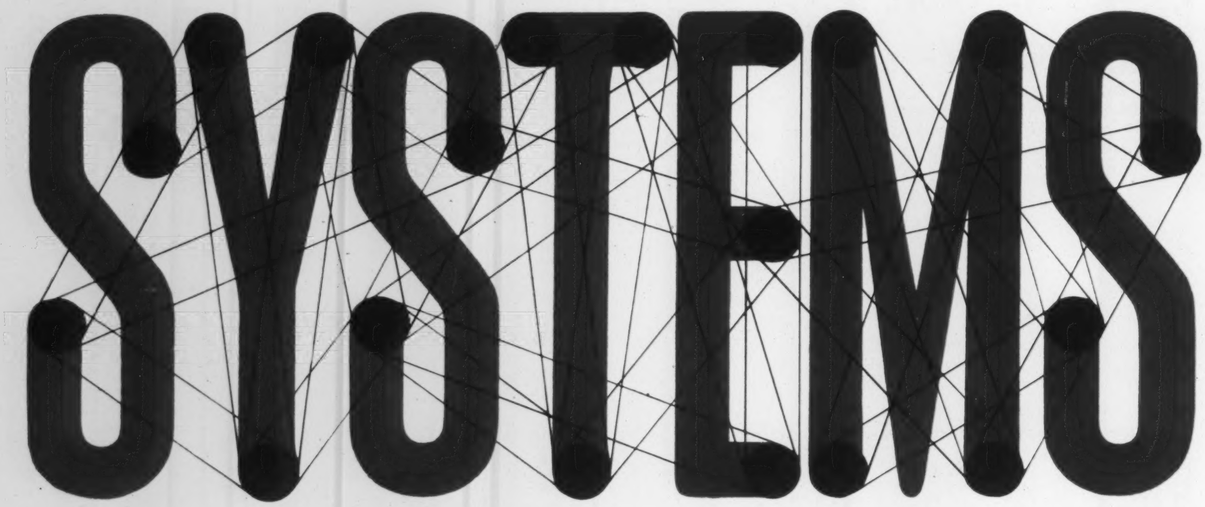
For further information, please address your inquiry with an indication of your background to **Mr. Fred E. Lee.**

GENERAL DYNAMICS

STROMBERG-CARLSON DIVISION

1477 N. Goodman St., Rochester 3, New York

You can explore new areas at IBM in



Electronic systems engineering covers the full spectrum of applied research and development at IBM. With this broad, flexible range, and IBM's outstanding resources and facilities, your own imagination and creativeness will find unusual opportunity for expression. Currently, IBM engineers and scientists concerned with broad systems problems in business, science and government are working toward self-optimizing computers. These computers may some day program themselves and arrive at the one solution to a problem. Digital computers are being applied to simulate all the problems of a business firm operating under specified economic and statistical conditions. Progress is being made in advanced studies for radically different data systems for terrestrial and stellar navigational problems. For problems like these, and many others, IBM needs people who want to convert challenges into careers.

A NEW WORLD OF OPPORTUNITY. Both technical and administrative engineering careers offer parallel advancement opportunities and rewards at IBM. You will enjoy unusual professional freedom, comprehensive education programs, the assistance of specialists of diverse disciplines, and IBM's wealth of systems know-how. Working independently or as a member of a small team, your individual contributions are quickly recognized and rewarded. This is a unique opportunity for a career with a company that has an outstanding growth record.

CAREERS AVAILABLE IN THESE AREAS . . .

APPLIED MATHEMATICS & STATISTICS
CIRCUIT DESIGN & DEVELOPMENT
COMPONENT ENGINEERING
COMPUTER ANALYSIS
CRYOGENICS
FLIGHT TEST ANALYSIS
HUMAN FACTORS
INERTIAL GUIDANCE
INFORMATION THEORY
LOGICAL DESIGN
OPERATIONS RESEARCH
PROGRAMMING
RADAR CIRCUITRY
THEORETICAL PHYSICS
TRANSISTOR DESIGN

QUALIFICATIONS:

B.S., M.S., or Ph.D. in Electrical or Mechanical Engineering, Physics, or Mathematics—and proven ability to assume a high degree of technical responsibility in your sphere of interest.

GENERAL DESCRIPTIONS OF SOME ASSIGNMENTS:

INERTIAL GUIDANCE ENGINEER to assume broad project leadership in the planning and controlling of development projects. Analyze relationship of inertial equipment with bombing and navigation computer. Must have experience in servo-mechanisms, astro-compass or similar devices.

COMPUTER ENGINEER to perform physical, mathematical analyses for solving complex control problems by use of digital computers. Applications in missile systems and special-purpose computer systems such as DDA plus extensive experience in computer analyses.

RADAR ENGINEER to analyze ultimate limits and present techniques and to develop new concepts providing topographical sensors for advanced airborne and space systems. Design airborne radar pulse, microwave and deflection circuitry. Analyze doppler radar systems to determine theoretical accuracy and performance limitations. Experience with transistor circuits or radar test equipment is highly desirable.

TRANSISTOR ENGINEER to design transistor amplifiers, delay lines, transistor-tube conversion circuits, and develop specifications for transistorized equipment.

ENGINEERING PHYSICIST to assist in design and development of advanced solid state computers. Must have extensive background in electronic fundamentals plus knowledge of solid state phenomena and mathematics. Must be capable of participating in logic development with minimum supervision.

For details, write, outlining background and interests, to: **Mr. R. E. Rodgers**
Dept. 598C
IBM Corp.
590 Madison Avenue
New York 22, N. Y.

IBM®

INTERNATIONAL BUSINESS MACHINES CORPORATION

TWO INSTRUCTORS for instrumentation courses in training school conducted by long-established, major instrument-manufacturer. Previous teaching experience desirable, with degree in physics or electrical, mechanical, or chemical engineering. Duties include organizing and conducting one-week to three-month courses, repeated several times yearly, for field-engineering trainees of company and for customers' instrument-technicians. Subject matter covers operating principles, construction, installation, and maintenance of indicators, recorders, controllers, and telemetering equipment for pressure, temperature, flow, liquid-level, etc.; self-balancing potentiometers and bridges; pneumatic and electric valves; etc. These are new jobs created because of steadily increasing demand for company's products and services. Salary is open and will be made definitely attractive to the right men. Write C. F. Johnson, Manager Education, The Bristol Company, Waterbury 20, Connecticut.

CHEMICAL OR MECHANICAL ENGINEER

Graduate with 1–5 years' experience in industrial water treatment to coordinate activities of several steam generating stations in an upstate New York utility, with respect to water supply, analysis and treatment; waste disposal; corrosion problems; coal sampling and related problems. A responsible job with a good employer. Salary open. Liberal benefits. Send resume and general salary requirement.

Address CA-6619, % "Mechanical Engineering."

CHIEF DESIGN ENGINEER

Supervisory responsibility for initiating the development and design of valves and valve actuators for growth markets such as power, petroleum, chemical processing and marine. Engineering degree and design experience essential. Reports directly to Chief Engineer regarding all design engineering. Company is a leader in the valve industry. Can offer top flight position to right person. Send complete resume in confidence.

Address CA-6629, % "Mechanical Engineering."

SENIOR AND JUNIOR MECHANICAL DEVELOPMENT ENGINEERS

One Senior Mechanical Development Engineer with advanced technical education in mechanical engineering and applied mechanics with ten to twenty years' experience in design and development of heavy machinery. Permanent position with well established heavy machinery builder to the steel and allied industry. Salary $12,000 to $15,000 per year. Also, one Junior Mechanical and Development Engineer, similar training, five to ten years' experience, salary $9,000 to $12,000 per year. Location Pittsburgh.

Address CA-6614, care of "Mechanical Engineering."

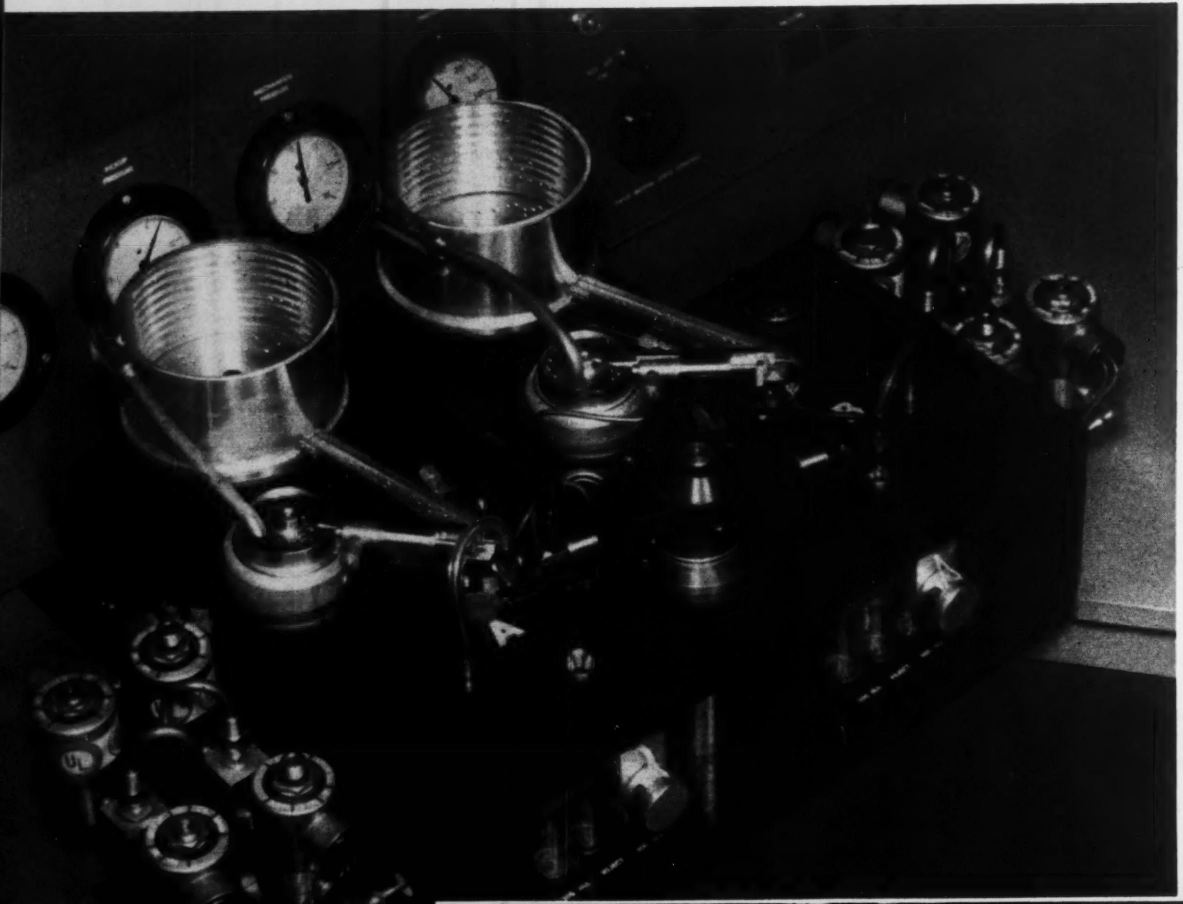
Science and Engineering at Robert College of Istanbul

Opportunities at Robert College in Istanbul, Turkey for qualified men in engineering, mathematics, physics, and chemistry interested in combining teaching and consulting with the opportunity to live and travel in a vital part of the world. Development program is in effect to strengthen staff, modernize undergraduate curricula, inaugurate graduate program, construct new science and engineering building, prepare engineers for the industrial and technological development of Turkey and the Middle East. A challenging work with far-reaching possibilities.

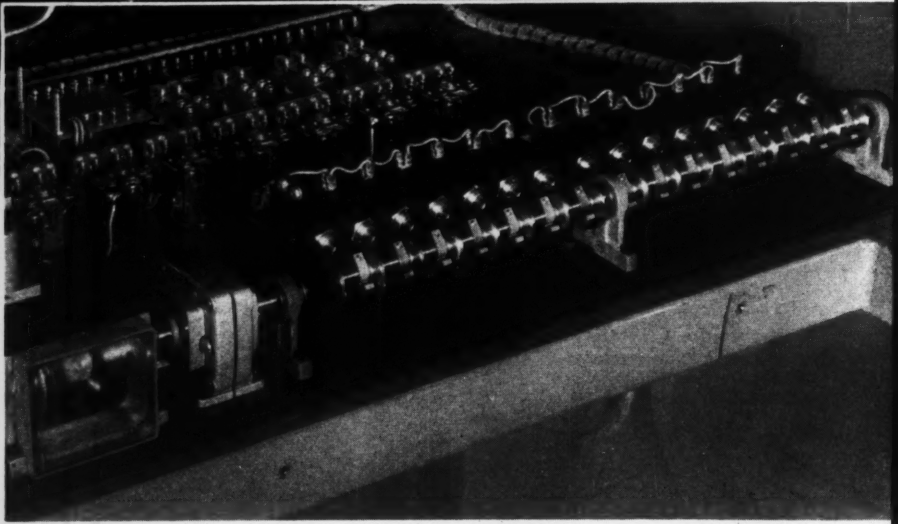
Address inquiries to Dr. Duncan S. Ballantine, President, or Dean Howard P. Hall of the College of Engineering at Robert College, Bebek P.K. 8, Istanbul, Turkey with copy to the Near East College Association, 40 Worth Street, New York 13, New York.

DESIGN AND MECHANIZATION OPPORTUNITIES . . .

From Wafers to Wave



Wafers for TI diodes or rectifiers are loaded in the vibrating feeding devices that pass them through synchronized pick-up stations. Here they are vacuum gripped between sets of test points at either end of an oscillating arm, and electrical tests of several parameters on each wafer are performed during transit to the discharge area. Results of the tests trip the proper trap door allowing the wafer to fall into the right stock vial.



This fully automatic silicon wafer sorting machine was designed and built by mechanization engineers at the TI Semiconductor-Components division. Working with product engineering and electronic test equipment design groups, the equipment was designed to test several parameters on each wafer at a rate of more than 4000 per hour. View above shows row of 24 precision cam-actuated micro-switches that program the various vacuum, pneumatic and electrical operating functions during each cycle.

Guides

Ever-increasing demands of Space Age technology at Texas Instruments have created permanent professional openings for gifted Mechanical Engineers. Opportunities in the Semiconductor-Components and Apparatus divisions vary widely in the fields of engineering design and production line mechanization. ME's at TI find substantial design freedom to immunize systems and components against heat, cold, vibration, shock, and reliability pitfalls in this engineer-managed 29-year old company.

Take a recognized part in the planned steady growth of dynamic Texas Instruments. In the last year alone, the Apparatus division more than doubled its plant size and the Semiconductor-Components division opened the world's largest semiconductor facility (over seven acres under one roof) and began construction on a four-acre addition. Texas Instruments annual sales rate during the past ten years has grown 18-fold to $91 million in 1958 and the total number of TI'ers has increased nine times during the same period to nearly 8000.

Texas Instruments Apparatus and Semiconductor-Components division plants are located in Dallas but away from downtown traffic, near excellent residential areas with highly rated schools and fine shopping centers. At TI you will live just minutes away from work . . . in the entertainment, cultural, recreational and electronics capital of the Southwest. Up-to-date personnel benefits include company-sponsored profit-sharing, educational assistance, semi-annual salary reviews, insurance, and retirement programs.

Semiconductor-Components division

Mechanical Engineers with one to 10 years experience, including those who have worked in semiconductor or vacuum tube activities, and who have designed manufacturing and prototype equipment. This equipment includes complex high-speed, automatic and semi-automatic machines ranging through miniature rotating, actuating and sensing devices; gyro and servo mechanisms; relays, thermosensors and micro-miniature devices.

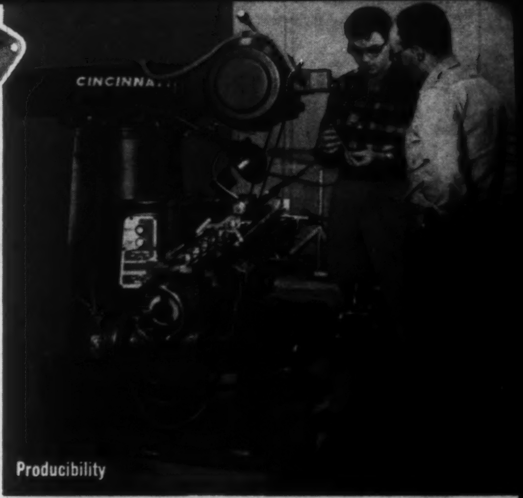
Please write H. C. Laur
Semiconductor-Components division;
Dept. 2807

Apparatus division

Mechanical Engineers with three to 10 years experience related to the following fields are invited to discuss your qualifications in confidence: antenna design — electronics equipment — precision mechanism design — miniaturization — thermodynamic design — refrigeration and insulation — electronics packaging — structural design — tooling design and manufacturing engineering.

Please write J. R. Pinkston
Apparatus division;
Dept. 2807

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE • DALLAS 9, TEXAS

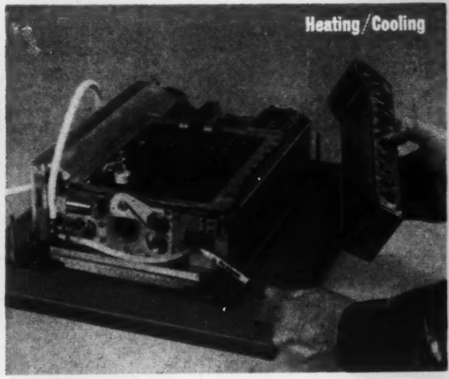


Producibility

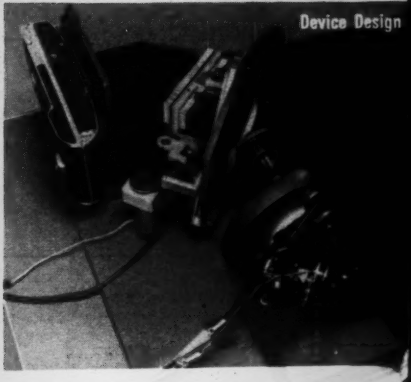
Packaging

Reliability

Vibration



Heating/Cooling



Device Design

ENGINEERING SPECIALISTS WANTED

Page reserved for advertisements to experienced engineering specialists to fill immediate openings.

DESIGN ENGINEERS FOR ALUMINUM PRODUCT DEVELOPMENT

With design experience in the application of aluminum in architecture and construction, automotive, trucks and trailers, railway, marine, process industry appliances, etc., for work in the Metals Research Laboratories of Olin Mathieson Chemical Corporation, New Haven, Connecticut. Pleasant living conditions, opportunities for advancement. Apply to

E. R. Patterson, Employment Manager
Olin Mathieson Chemical Corporation
New Haven, Conn.

MECHANICAL ENGINEERS

IS THIS YOU? . . . M.E. with proved (or strongly suspected) talent for dreaming up and carrying through unusual mechanical research and development projects . . . who hankers for a spot ideally between the frustrations of an ivory tower and dull routine . . . who hungers to have his abilities take him as far as possible with rewards in proportion.

THIS IS BATTELLE . . . One of the world's greatest research centers; not for profit but specializing in sponsored work; solving industry's problems in a practical way. Splendidly housed and equipped. Located adjacent to The Ohio State University (further study arranged). Highly skilled technicians to implement your research. Best of living and recreation facilities minutes away. Top benefits program.

THESE ARE THE FIELDS . . . Machine design and development, stress analysis, vibrations, internal combustion engines, propulsion, equipment systems, instrumentation, reactor engineering and related fields . . . write today for prompt consideration to

The Personnel Manager
BATTELLE MEMORIAL INSTITUTE
505 King Avenue
Columbus 1, Ohio

Opportunities Unlimited

ENGINEERING SOCIETIES PERSONNEL SERVICE INC. (AGENCY)

SECURITY...TOP WAGES...CHALLENGING ASSIGNMENTS

Qualified Engineers! Thousands of positions available with leading organizations . . . Employer pays fee in many cases.

Under the auspices of the Five Founder Engineering Societies and affiliated with other renowned Engineering Societies, E.S.P.S. offers many years of placement experience in addition to world wide contacts.

Write for E.S.P.S. weekly Bulletin of Positions Available . . . See a partial listing of available positions in Personnel Section.

DON'T DELAY—REGISTER TODAY

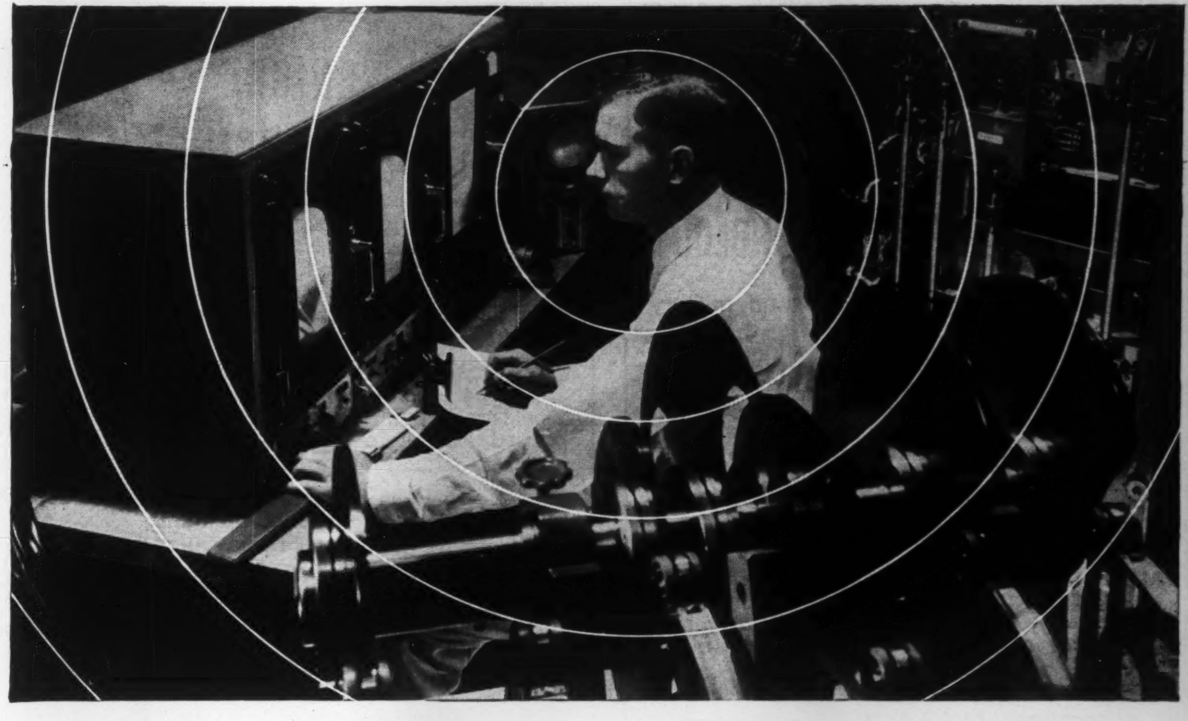
Offices In Major Cities In U. S.

New York
8 West 40th St.

Chicago
84 East Randolph St.

Detroit
100 Farnsworth Ave.

San Francisco
57 Post St.



How far can an engineer go at AC?

You can use and develop all your talents in AC's bustling instrumentation business.

You can put the finest equipment to work for you . . . on interesting and varied projects . . . at AC's world-wide facilities. What's more, you can enhance your professional status by working on advanced degrees in engineering schools located near AC plants.

All this plus the comfort of long range security. For today AC turns out the AChiever inertial guidance system and many other electro-mechanical, optical and infra-red devices. Tomorrow you'll help AC produce instrumentation devices for the "space age."

If you are a physicist, mathematician, or graduate engineer in the electronics, electrical or mechanical fields—*you can go places at AC, because AC is going places.*

Talk to the people at AC about it soon. Just write the Director of Scientific and Professional Employment: Mr. Robert Allen, Oak Creek Plant, Box 746, South Milwaukee, Wisconsin; or Mr. M. Levett, Dept. F, 1300 N. Dort Highway, Flint 2, Michigan.

Inertial Guidance Systems • Afterburner Fuel Controls • Bombing Navigational Computers • Gun-Bomb-Rocket Sights • Gyro-Accelerometers • Gyroscopes Speed Sensitive Switches • Speed Sensors • Torquemeters • Vibacall • Skyphone

AC SPARK PLUG ⚛ THE ELECTRONICS DIVISION OF GENERAL MOTORS

RESEARCH DEVELOPMENT SCIENTISTS and ENGINEERS
for
HIGH TEMPERATURE TECHNOLOGY

Rapidly expanding commercial and military programs in

ARC, FLAME, and DETONATION PROCESSES and DEVICES

for use in forming metal and ceramic coatings and shapes, aerodynamic and materials testing, refractory crystal growth and characterization, and plasma physics-magnetohydrodynamics research have created a number of outstanding opportunities for

METALLURGISTS
ENGINEERING PHYSICISTS
PLASMA PHYSICISTS
PHYSICAL CHEMISTS

ENGINEERS
Mechanical
Electrical
Aeronautical

Examples of specific openings include:

ELECTRICAL ENGINEER . . . experimental, theoretical, and design work on power supplies and circuit for large (megawatt d.c. and a.c. plasma generators. Knowledge of power, instrumentation, industrial and physical electronics, and an interest in gaseous discharge and arcs are desirable.

ENGINEERING PHYSICIST . . . experimental work on arc and flame processes for producing single crystals of such materials as yttrium iron garnet, refractory metal compounds. Knowledge of crystallography and background in solid state physics desirable.

PHYSICAL METALLURGIST . . . development work on arc, flame, and detonation processes for depositing coatings or forming shapes of refractory metals and ceramics. Background in gas dynamics and metallography desirable.

All positions offer attractive salaries, excellent benefits and stable employment for capable professional men who desire to work in these challenging areas at a modern laboratory of a leading industrial firm. If interested, please send resume covering education (approximate academic achievement), experience and work interests.

LINDE COMPANY
division of
UNION CARBIDE CORPORATION
1500 Polco Street
Indianapolis 24, Indiana
Attention Mr.J. J. Rostosky
Refer to ad: ME-A

SENIOR RESEARCH ENGINEERS

Exceptional positions are open for experienced men capable of guiding and developing interesting research programs in the fields of Heat Power Equipment and Fluid Power Equipment with major emphasis on gas turbines, piston engines or fluid components.

An M.S. or Ph.D. in Mechanical Engineering and extensive experience in the above fields required. These men must be recognized leaders in the areas of Thermodynamics, Fluid Flow or Heat Transfer.

These positions offer an opportunity to use your initiative and creative ability. Excellent employee benefits including liberal vacation policity. Please send complete resume to:

E. P. Bloch
ARMOUR RESEARCH FOUNDATION
Illinois Institute of Technology
10 West 35th Street
Chicago 16, Illinois

MECHANICAL ENGINEERING
February, 1959 **CARD INDEX** **Vol. 81, No. 2**

ASME's Research Committee Program, E. M. Barber........ 48
NSF's Basic-Engineering Research Program, G. M. Nordby and R. H. Long, Jr........ 52
The Utilization of Waste Heat, J. H. Potter........ 54
The Convair "600" Jet Transport, J. T. Ready, Jr........ 59
Viscoelasticity in Lubrication, G. J. O'Donnell........ 63
Progress in Railway Mechanical Engineering 1957–1958........ 66
Editorial........ 47
Briefing the Record........ 79
Photo Briefs........ 88
European Survey........ 92
ASME Technical Digest........ 94
Comments on Papers........ 108
Books Received in Library........ 110
ASME Boiler and Pressure Vessel Code........ 111
The Roundup........ 114
The ASME News........ 127

Hydraulics Engineer

We require centrifugal pump designer with 5 to 10 years' experience. Specific responsibilities will be in the development and design of impellers, volutes and diffusers and to establish internal flow conditions to determine pressure drop, thrust and fluid friction in nuclear systems pumping applications.

This is a position of senior engineering status. Salary is open, depending on qualifications.

Westinghouse ELECTRIC CORPORATION
ATOMIC EQUIPMENT DEPARTMENT

Address inquiries to Professional Employment, Cheswick, Pennsylvania.

Frontiers are extended by the practical visionary

It is the practical visionary who has given us much of what we enjoy today. And it will be the visionary—the man with ability to seek concepts beyond the existing limitations of science—who will guide our developments of tomorrow.

The Applied Physics Laboratory (APL) of The Johns Hopkins University seeks men who will be engaged in advanced research problems—who will find solutions to problems yet to be posed. Their findings will provide guidelines for the space and missile hardware research of the future.

Your endeavors will be heightened by the professional atmosphere of APL. This atmosphere, created by men dedicated to the furtherance of science, has earned APL a reputation as a leader in programs vital to the national security.

Appointments at APL offer exceptional opportunities. For detailed information, address your inquiry to:
Professional Staff Appointments

The Johns Hopkins University Applied Physics Laboratory

8607 Georgia Avenue, Silver Spring, Maryland

SCIENTISTS
are
people. . .

. . . and scientists and their families enjoy the combination of creative work and stimulating living that Los Alamos offers. There is exciting adventure here in developing the sources and uses of nuclear energy in the age of space exploration. Here too is an uncrowded community, a healthful climate, cool summers and mild winters, in a high mountain forest setting of spectacular beauty.

Employment inquiries are invited from highly qualified people in the physical sciences and engineering. Write to:

Director of Personnel
Division 59-26

los alamos
scientific laboratory
OF THE UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

ENGINEER, ME

Advancements Available in
Heat Transfer
Equipment Development

Outstanding career opportunity with leading manufacturer of air conditioning and heat transfer equipment. Start as Assistant to Senior Development Engineer of Heat Transfer Equipment. Work in new multimillion dollar engineering and research center of rapidly expanding organization. Experience in heat transfer engineering required. Problems involve the selection of heat transfer surface for a range of conditions from −300° to +2000°.

Liberal benefits and retirement program. Community of 50,000 in Wisconsin vacationland. Write listing education, experience and salary requirements to G. E. Hassell, Staff Employment.

THE TRANE COMPANY
LA CROSSE, WISCONSIN

Engineers • Scientists

R&D Opportunities
in California
with Sylvania

MECHANICAL TUBE ENGINEERS
Perform mechanical design & test of tubes, components and tooling. 5 years' experience in mechanical design, testing & evaluating special purpose tubes.

MECHANICAL DESIGN ENGINEERS
Electromechanical design of electronic equipment. Background in microwave systems & antennas desirable.

ELECTRONIC PACKAGING
Packaging of airborne electronic subminiaturized equipment. 7 or more years' experience in electromechanical packaging of electronic equipment desired.

ELECTRONIC DEFENSE LAB
RECONNAISSANCE SYSTEMS LAB
MICROWAVE TUBE LAB
MICROWAVE PHYSICS LAB

Please send resume to
Mr. Wayne Pearson

SYLVANIA
SYLVANIA ELECTRIC PRODUCTS INC

P.O. Box 188, Mountain View, Calif.
(On the San Francisco Bay peninsula)

POSITIONS OPEN

Mechanical Engineers

Highly Creative Engineer . . .

for challenging work in the design of systems and equipment in the food processing field. Thorough grasp of engineering fundamentals and experimental procedures necessary. BSME or BS ChE with five years' experience.

Research Mechanical Engineers . . .

to design food processing equipment or packaging machinery. Top level BSME's with sound background in engineering fundamentals. Experience desirable.

- **career opportunity**
- **relocation allowance**
- **extensive benefit program**

Send complete resume to:

General Mills

Personnel, Room G
Central Research Laboratories
2010 East Hennepin Ave.
Minneapolis 13, Minn.

DESIGN ENGINEER WANTED

Prominent Eastern Manufacturer of Locomotive and Passenger Car Trucks has excellent opening for a man to serve as Assistant Chief Design Engineer.

Position offers interesting challenge along with a good starting salary and excellent opportunity of early advancement to aggressive man possessing required ability, training and imagination.

Address CA-6628, % "Mechanical Engineering."

ASSOCIATE and ASSISTANT PROFESSORS for fields of advanced dynamics, advanced strength, and elasticity. Also have opening for graduate student as half-time instructor. Engineering Mechanics Dept., Kansas University, Lawrence, Kansas.

OPPORTUNITY with expanding saw mill machine manufacturer for M.E. grad. with heavy equipment design experience. Pleasant college town living advantages. Mater Machine Works, Inc., Corvallis, Oregon.

ASSISTANT OR ASSOCIATE PROFESSOR. Will be responsible for courses in the aeronautics option including aerodynamics and airplane performance. Starting fall term 1959. Industrial experience and master's degree perferred. Department of Mechanical Engineering, Oregon State College, Corvallis, Oregon.

Asst. or Assoc. Prof. in Mech. Engrg. Special emphasis on vibrations, stress analysis and dynamics. Must have strong interest and competence in developing laboratories. Master's degree; teaching and industrial experience. Write to S. Brooks Walton, head, Mech. Engrg. Dept., San Jose State College, San Jose, Calif.

TRANSLATORS. Proven ability to translate technical material into fluent English essential. Attractive full time or free-lance arrangement. All languages of interest, particularly Russian. Send resume to: A.T.S., Inc., Drawer 271, East Orange, N. J.

POSITIONS WANTED

MECHANICAL ENGINEER—5$^1/_2$ years' experience electromechanical systems, structural design, aircraft test equipment, research and automatic controls, seeks position in Europe. Address CA-6630, care of "Mechanical Engineering."

MECHANICAL ENGINEER—age 30. Norwegian, now completing studies at Munich Technical University (Dipl. Ing.) desires employment with U. S. mechanical engineering firm outside U. S., preferably in an underdeveloped country after April 1, 1959. Address CA-6632, care of "Mechanical Engineering."

TEACHING & RESEARCH: Ph.D. in Applied Mechanics & M.S. in Mechanical Engineering, 16 years' teaching & research experiences, desires teaching or/and research. Address CA-6638, care of "Mechanical Engineering."

EMPLOYMENT AGENCIES AND SERVICE BUREAUS

SALARIED POSITIONS—$6,000 to $35,000. We offer the original personal employment service (established 48 years). Procedure of high standards individualized to your personal requirements. Identity covered. Particulars—R. W. Bixby, Inc., 562 Brisbane Bldg., Buffalo 3, N. Y.

SALARIED PERSONNEL $5,000 to $30,00. This nation-wide service successful since 1927 finds openings in your field. Sells your abilities; arranges contacts. Present position protected. Write for details—Jira Thayer Jennings, P. O. Box 674, Manchester, Vermont.

REPRESENTATION WANTED

MANUFACTURER of Heat Exchangers and Pressure Vessels, located in New Jersey, wants sales representatives in various parts of country. Representative should have contacts in oil refineries, power plants, chemical plants or marine. Address CA-6550, care of "Mechanical Engineering."

REPRESENTATIVES AVAILABLE
REPRESENTATION WANTED
BUSINESS OPPORTUNITIES
MANUFACTURING FACILITIES
EQUIPMENT FOR SALE
EQUIPMENT WANTED
HELP WANTED
POSITIONS WANTED
EMPLOYMENT AGENCIES
AND SERVICE BUREAUS

If you desire capital or have it to invest; if you have a patent for sale or development; if you have on hand used machinery for disposal, or if you want such equipment; if you have copies of publications, or a set of drawing instruments to dispose of; if you need help or want a position, in fact, anything to be offered that somebody else may want, or anything wanted that somebody else may have—use a classified advertisement in MECHANICAL ENGINEERING for quick results.

CONSULTING SERVICE

Manufacturers of Equipment not included

RATES: One-inch card announcements inserted at rate of $25 each issue, $20 per issue on yearly contract

BLACK & VEATCH
CONSULTING ENGINEERS
Electricity—Water—Sewage—Industry
Reports, Designs, Supervision of Construction
Investigations, Valuation and Rates
1500 Meadow Lake Parkway, Kansas City 14, Mo.

The Kuljian Corporation
ENGINEERS • CONSTRUCTORS • CONSULTANTS
POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
UTILITY • INDUSTRIAL • CHEMICAL
1200 N. BROAD ST., PHILA. 21, PA.

PROPANE GAS PLANTS
and
Anhydrous Ammonia Plants
PEACOCK CORPORATION
Box 268, Westfield, N. J. Adams 2-6258

GAI
GILBERT ASSOCIATES, INC.
Engineers and Consultants
Design and Supervision of Construction
Mechanical • Electrical • Nuclear
Sanitary • Chemical Laboratory
Business and Economic Research
New York **READING, PA.** Washington

PETER F. LOFTUS CORPORATION
PFLC ESTABLISHED 1923
Design and Consulting Engineers
Electrical • Mechanical
Structural • Civil
Nuclear • Architectural
FIRST NATIONAL BANK BUILDING
Pittsburgh 22, Pennsylvania

Power Plants, Structures
Transmission Systems
Design, Supervision, Inspection
Appraisals, Reports
SARGENT & LUNDY
140 S. Dearborn St., Chicago, Ill.

HARZA ENGINEERING COMPANY
CONSULTING ENGINEERS
E. Montiford Fucik Calvin V. Davis
Richard D. Harza
Hydroelectric Plants and Dams
Transmission Lines
Flood Control Irrigation
River Basin Development
400 West Madison Street Chicago 6

ARTHUR McCUTCHAN
PIPING ENGINEERING CONSULTANT
198 Ravenna Road Hudson, Ohio
Olympic 3-6370

STANLEY ENGINEERING COMPANY
Consulting Engineers
Hershey Building 208 S. LaSalle Street
Muscatine, Ia. Chicago 4, Illinois
1154 Hanna Building
Cleveland 15, Ohio

JACKSON & MORELAND, INC.
JACKSON & MORELAND INTERNATIONAL, Inc.
Engineers and Consultants
Electrical—Mechanical—Structural
Design and Supervision of Construction for
Utility, Industrial and Atomic Projects
Surveys—Appraisals—Reports
Machine Design—Technical Publications
BOSTON NEW YORK

JOHN W. MEDLIN
CONSULTING ENGINEER
Design of Machines, Refrigeration Systems,
Pressure Vessels, Pilot Plants
5210 Morningside Houston 5, Texas

SVERDRUP & PARCEL
Engineers—Consultants
Design • Construction Supervision
Steam and Hydroelectric Power Plants
Power Systems • Industrial Plants
Studies • Reports
San Francisco ST. LOUIS Washington

M. W. KELLOGG
Piping Systems Flexibility Analyses
SEND FOR BOOKLET
DESCRIBING THIS SERVICE
The M. W. Kellogg Company
711 Third Avenue, New York 17, N. Y.

WELD TESTING
Qualification of Operators—Supervision
Inspection—Research
NATIONAL WELD TESTING BUREAU
Pittsburgh Testing Laboratory, Pittsburgh, Pa.

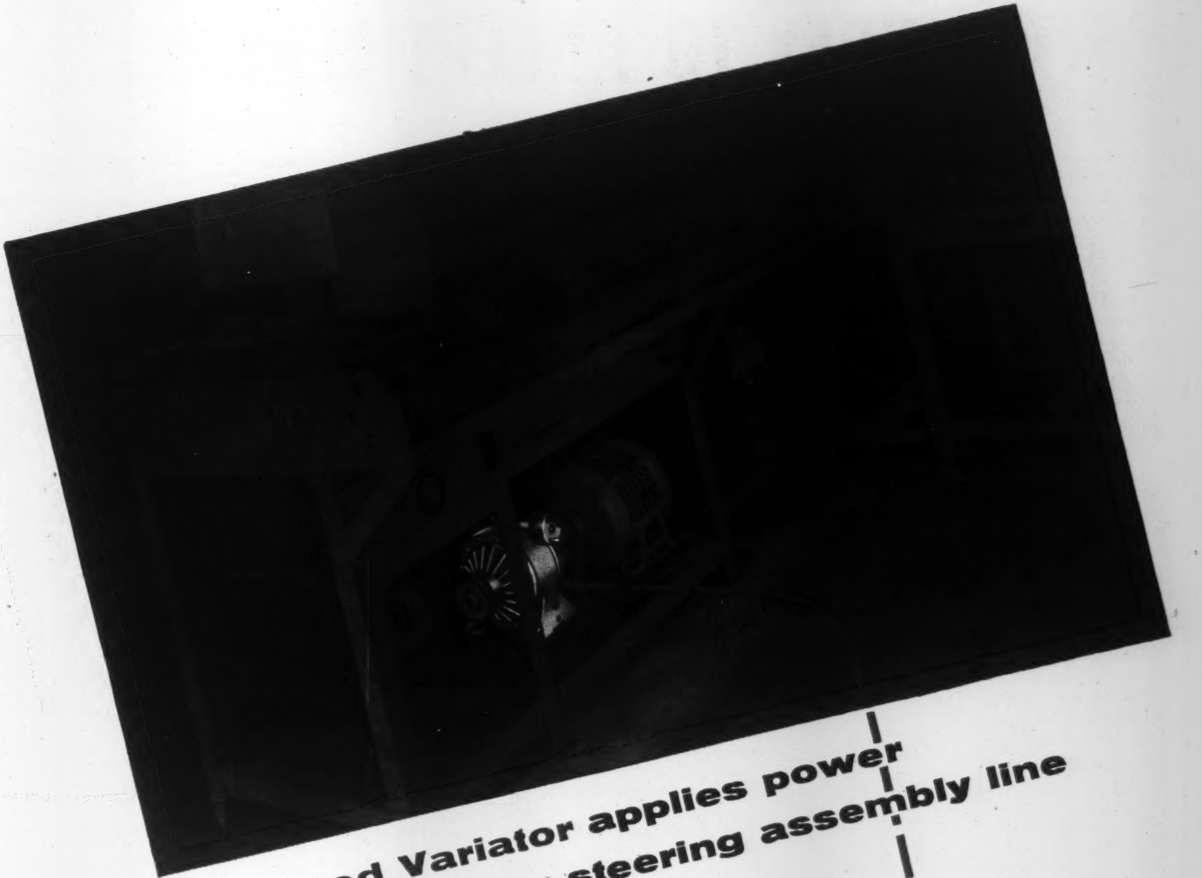
TERMEC S.A.
Engineers and Consultants
for
LATIN AMERICA
Petroleum Field and Industrial
Applications; Corrosion Mitigation
Apartado Este 4575 Cable: TERMEC
Caracas, Venezuela

The above consultants are available to work out solutions to your engineering and management problems.

An announcement in this section

will acquaint others

with your specialized practice.



Cleveland Speed Variator applies power to power-steering assembly line

Providing variable speeds to the final inspection and assembly conveyer on a power steering gear generator line is a Cleveland Speed Variator. This Cleveland was chosen for its infinitely variable speeds which enable management to obtain a desired number of units per day by merely selecting a suitable conveyer output speed.

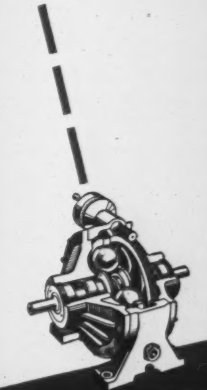
One of 22 Variators in the plant, this installation of a Cleveland Speed Variator has a side benefit to labor and management by eliminating problems stemming from disputed conveyer speeds.

Other advantages of Cleveland Speed Variators include: 1. Clockwise or counterclockwise input speeds to 1800 rpm; 2. Constant horsepower output over a 9:1 range, or constant output torque over a 6:1 range; 3. Rapid response to speed changes, precise adjustments, accurate adherence to settings; 4. Long life with minimum maintenance; 5. Ample bearing support for overhung pulleys on either input or output shafts; 6. Compact design.

Write today for illustrated Bulletin K-200 for complete specifications, sectional drawings and rating tables on the full line of Cleveland Speed Variators.

The Cleveland Worm & Gear Company, Speed Variator Division, 3264 East 80th Street, Cleveland 4, Ohio.

Sales representatives in all major industrial markets.
In Canada: Peacock Brothers Limited.



CLEVELAND

SPEED VARIATOR

INDEX TO ADVERTISERS

- AC Electronics Div.
  - General Motors Corp 197
- Aerojet-General Corp 145
- *Air Preheater Corp 183
- All American Tool & Mfg. Co. 170
- Allen-Bradley Co. 206
- *Allis-Chalmers Mfg. Co.
  - Hydraulic Div. 36
- American Hollow Boring Co. 152
- ASME Publications 184
  - Mechanical Catalog 160
- Armour Research Foundation 198
- Associated Spring Corp 1
- Atomics International Div.,
  - North American Aviation (Inc.) 182

- *B-L-H, Loewy Hydropress Div. 30
- *Babcock & Wilcox Co.
  - Boiler Div. 2nd Cover
  - Tubular Products Div. 4
- Battelle Memorial Institute 196
- Bituminous Coal Institute 176, 177
- Boston Gear Works 157
- Bridgeport Thermostat Div.,
  - Robertshaw-Fulton Controls Co. 173, 174
- *Buffalo Forge Co. 21
- *Bunting Brass & Bronze Co. 163
- Burroughs Corp. 150
- Byers, A. M., Co. 31

- C.E.M. Co. 12
- *Chicago Bridge & Iron Co. 190
- Clarage Fan Co. 175
- Cleveland Worm & Gear Co. 203
- *Columbia-Geneva Steel Div. 6, 7
- *Consolidated Chimney Co. 164
- Curtis Mfg. Co.
  - Pneumatic Div. 168
  - Refrigeration Div. 39

- Dean Bros. Pumps (Inc.) 2
- DeZurik Corp. 189
- *Dresser Industries (Inc.) 25
  - *Roots-Connersville Blower Div. 27

- Eagle Pencil Co. 38

- Faber, Eberhard, Pencil Co. 145
- *Fairbanks, Morse & Co.
  - Pump Div. 149
- Fiske Bros. Refining Co.
  - Lubriplate Div. 162
- *Flexonics Corp 32
- Foote Bros. Gear & Machine Corp. 165
- Fulton-Sylphon Div.
  - Robertshaw-Fulton Controls Co. 147
- Funk Mfg. Co. 188

- German-American Chamber of Commerce 170
- *Golden-Anderson Valve Spec. Co. 166
- *Green Fuel Economizer Co. 35

- Hagan Chemicals & Controls (Inc.) 186

- Imperial Tracing Cloth 189
- International Business Machines 192, 193
- International Nickel Co. 42

- Jenkins Bros. 140
- Jet Propulsion Laboratory
  - Div. Calif. Institute of Tech. 185
- Johns Hopkins University 199
- Johnson, Carlyle, Machine Co. 23
- Joy Mfg. Co. 16

- Keuffel & Esser Co. 28
- Koppers Co.
  - Fast's Coupling Dept 34

- *Ladish Co. 37
- Lenape Hydraulic Pressing & Forging Co. 142
- Linde Company
  - Div. of Union Carbide Corp. 198
- Lockheed Missile Systems 187
- *Loewy-Hydropress Div., B-L-H 30
- Los Alamos Scientific Lab. 200
- Lovejoy Flexible Coupling Co. 159
- Lubriplate Div.
  - Fiske Bros. Refining Co. 162
- Lunkenheimer Co. 3rd Cover

- McDonnell & Miller (Inc.) 169

- Nagle Pumps (Inc.) 158
- National Aeronautics and Space Administration 180
- National Distillers & Chemical Corp. 191
- *New York Blower Co. 153
- Niagara Blower Co. 151
- *Northern Blower Co. 148
- Nugent, Wm. W. & Co. 146

- Oldsmobile Div.
  - General Motors Corp. 22
- Olin Mathieson Chemical Corp. 196

- Palley Supply Co. 189
- *Pangborn Corp. 143
- *Peerless Pump Div.
  - Food Machinery & Chemical Corp. 40
- Pittsburgh Screw & Bolt Corp. 159
- *Posey Iron Works 188
- Powell, William, Co. 24

- Raybestos-Manhattan (Inc.)
  - Manhattan Rubber Div. 26
  - Packing Div. 205
- Reliance Gauge Column Co. 161
- Robertshaw-Fulton Controls Co.
  - Bridgeport Thermostat Div. 173, 174
  - Fulton-Sylphon Div. 147
- Rocketdyne Div.,
  - North American Aviation (Inc.) 158
- Rockford Clutch Div.
  - Borg-Warner 144
- *Roots-Connersville Blower Div.
  - Dresser Industries (Inc.) 27
- Rust-Oleum Corp. 18, 19

- Sandia Corp. 179
- Sheffield Corp. of Bendix Corp. 41
- Shenango Furnace Co. 154
- *Southwest Products Co. 188
- Stromberg-Carlson Div.
  - General Dynamics 191
- Sylvania Electric Products (Inc.) 200

- *Taylor Forge & Pipe Works 8, 9
- *Tennessee Coal & Iron Div. 6, 7
- *Terry Steam Turbine Co. 172
- Texas Instruments (Inc.) 194, 195
- Thomas Flexible Coupling Co. 164
- Timken Roller Bearing Co. 4th Cover
- Trane Co. 200

- United States Graphite Co.
  - Div. Wickes Corp. 14, 15
- United States Pipe & Foundry Co. 10, 11
- *United States Steel Corp. 6, 7
- *United States Steel Export Co. 6, 7

- Vickers (Inc.)
  - Div. Sperry Rand Corp. 33
- *Vogt, Henry, Machine Co. 29

- Western Gear Corp. 13
- Westinghouse Elect. Corp.
  - Atomic Equipment Dept. 198
- *Wickes Boiler Co.
  - Div. of Wickes Corp. 20
- Williams Gauge Co. 151
- Wollensak Optical Co. 167

- *Yarnall-Waring Co. 139
- Yoder Co. 162
- York Corp.
  - Sub. Borg-Warner Corp. 181
- *Yuba Consolidated Industries (Inc.) 17

- *Zallea Bros 171

*** The asterisk indicates that firm has product catalog in the 1959 Mechanical Catalog.**

Your attention is directed to

Keep Informed Section	141–170
Consulting Service	202
Opportunities	191–201
Engrg. Soc. Personnel Service (Agency)	134

Advertisers appearing in previous 1959 issues

Acme Chain Corp.
Addison-Wesley Publishing Co.
*Aerovent Fan Co.
*American Pulverizer Co.
American-Standard
  Industrial Div.
*Armstrong Machine Works

*Babcock & Wilcox
  Tubular Products Div., Fittings Dept.
*Badger Mfg. Co.
*Bailey Meter Co.
Barco Mfg. Co.
Bell Telephone Laboratories
Black, Sivalls & Bryson (Inc.)
*Blaw-Knox Co.
  Copes-Vulcan Div.
  Power Piping Div.
Bonney Forge & Tool Works
*Buffalo Pumps
  Div. Buffalo Forge Co.
Bundy Tubing Co.

Centrifix Corp.
Chace, W. M., Co.
Clearprint Paper Co.
*Combustion Engineering (Inc.)
Crane Co.

Diamond Chain Co. (Inc.)
*Diamond Power Specialty Corp.
Dudek & Bock Spring Mfg. Co.
du Pont, E. I., de Nemours & Co.

Eastman Kodak Co.
Edward Valves (Inc.)
  Sub. Rockwell Mfg. Co.

*Falk Corp.
Farrel-Birmingham Co.
Foxboro Co.
Frick Co.

*Gear Specialties (Inc.)
General Electric Co.
General Radio Co.
*Grinnell Co.

Hamilton Mfg. Co.
Homestead Valve Mfg. Co.

*James, D. O., Gear Mfg. Co.
Jeffrey Mfg. Co.

*Keeler, E., Co.
Kellogg, M. W., Co.

Lefax Publishers

Marsh Instrument Co.
  Affil. James P. Marsh Corp.
*Midwest Piping Co.

New Departure Div.,
  General Motors Corp.

Ozalid Div.
  General Aniline & Film Corp.

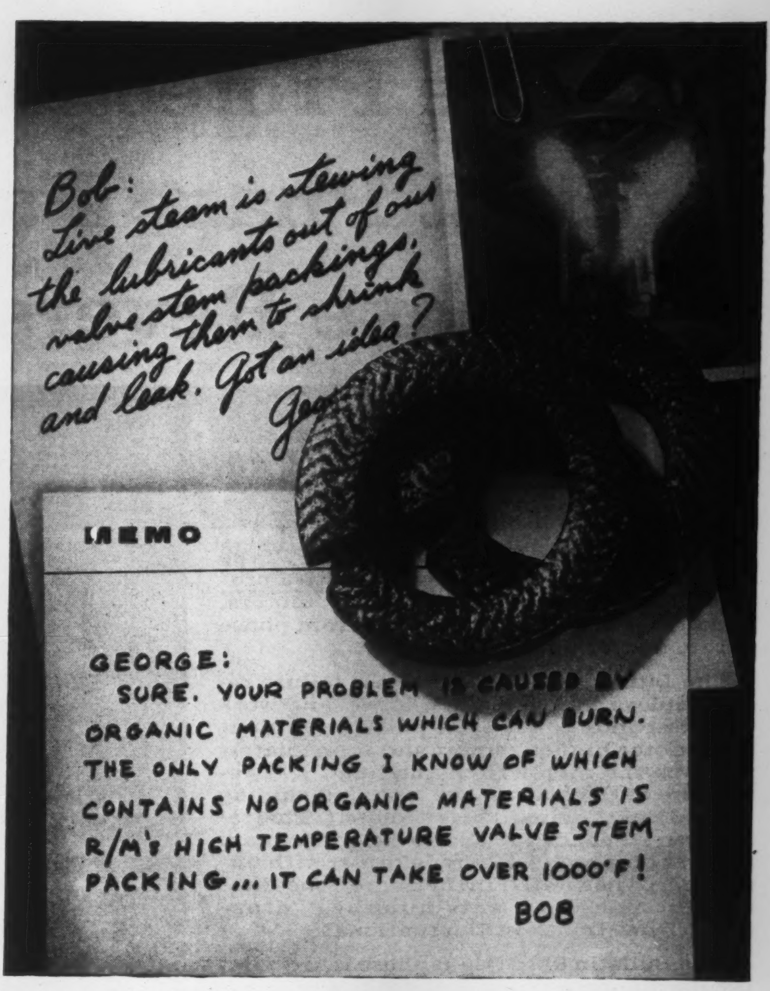
PIC Design Corp.
  Sub. Benrus Watch Co.
Perfection Gear Co.
  American Stock Gear Div
*Philadelphia Gear Corp.

Republic Flow Meters Co.
  Sub. Rockwell Mfg. Co.
Ronald Press Co.

*Sandusky Foundry & Machine Co.
Snap-Tite (Inc.)
Spraying Systems Co.
*Syntron Co.

*Voss, J. H. H., Co.

Westinghouse Elect. Corp.
  Sturtevant Div.
*Wheeler, C. H., Mfg. Co.
Winsmith (Inc.)



Bob:
Live steam is stewing
the lubricants out of our
valve stem packings,
causing them to shrink
and leak. Got an idea?
Geo

MEMO

GEORGE:
SURE. YOUR PROBLEM IS CAUSED BY
ORGANIC MATERIALS WHICH CAN BURN.
THE ONLY PACKING I KNOW OF WHICH
CONTAINS NO ORGANIC MATERIALS IS
R/M'S HIGH TEMPERATURE VALVE STEM
PACKING... IT CAN TAKE OVER 1000°F!
BOB

Your up-to-date boilers are producing steam at higher temperatures and pressures. Old-time valve-stem packings just can't stand the gaff. You can count on Raybestos-Manhattan for the safe, sure solution—packings specially designed to meet today's higher temperatures and pressures.

R/M high temperature valve-stem packings are made of top-quality braided asbestos with Monel wire reinforcement over a high temperature resistant plastic core. They contain practically no organic materials and the lubricants are thoroughly dispersed all the way through. It is this carefully engineered construction that makes them your best possible choice for all steam valves and rods.

R/M engineers have amassed a wealth of experience in manufacturing packings and gasket materials to satisfy the most exacting requirements of industry. This experience is at your disposal—call on R/M!

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS—including Vee-Flex,* Vee-Square,* Universal Plastic, and "versi-pak"*; GASKET MATERIALS; and "TEFLON"* PRODUCTS. SEE YOUR R/M DISTRIBUTOR.

*A Du Pont trademark

R/M

PACKINGS
RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

RAYBESTOS-MANHATTAN, INC., Mechanical Packings • Asbestos Textiles • Industrial Rubber • Engineered Plastics Sintered Metal Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings Brake Blocks • Clutch Facings • Industrial Adhesives • Bowling Balls • Laundry Pads and Covers

Positive Protection Against Phase Failure and Phase Reversal?

Here is your answer!

The Allen-Bradley Bulletin 812 Type F, Type R, and Type RF relays provide positive protection against the hazards to men, motors, and driven machinery, resulting from phase failure and/or phase reversals.

The Bulletin 812 Style F phase failure relay employs a unique static sensing network that responds to all open phase conditions on a motor branch circuit and immediately removes the motor from the line . . . irrespective of the load on the motor (including no load), or the circuit arrangement. This relay even responds to hard-to-detect primary failures on a wye-delta transformer with ungrounded neutral. Furthermore, the five-cycle response prevents nuisance "drop-outs" from transient fluctuations.

The Bulletin 812 Style R phase reversal relay disconnects the motor from the line—whether it is running or not—when a phase reversal occurs anywhere in the system on the line side of the relay. Thus, it can be employed for a single motor, a group of motors, or an entire power system. In addition, the phase reversal relay prevents the motor from starting should phase failure occur while at a standstill—a vital feature for elevator applications.

The Bulletin 812 Style RF relay combines the elements of Style R and Style F relays for protection against both phase failure and phase reversal. All Bulletin 812 relays are inherently "fail safe." Send for complete information.

Allen-Bradley Co., 1308 S. Second St.
Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd.
Galt, Ont.

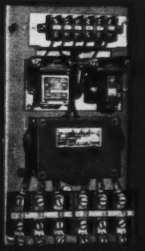
A-B
QUALITY

ALLEN-BRADLEY
QUALITY
MOTOR CONTROL

Bulletin 812, Style RF for Phase Failure *and* Phase Reversal

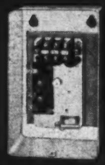
INDIVIDUAL RELAY UNITS AVAILABLE

For Phase Failure



Style F covers full load currents from 1.5 to 300 amp in 4 sizes. Coils for up to 600 v, 60 cycles.

For Phase Reversal



Style R made with coils for 110, 208/220, 440, 550 v for either 50 or 60 cycle operation.

Industry Standard for Lower Maintenance Costs

LQ600®

Here's Why: Long accepted valve maintenance costs are a thing of the past in thousands of plants where LQ600's have been installed . . . even in the most severe services where previous valves required repair or replacement after as little as two weeks on the line.

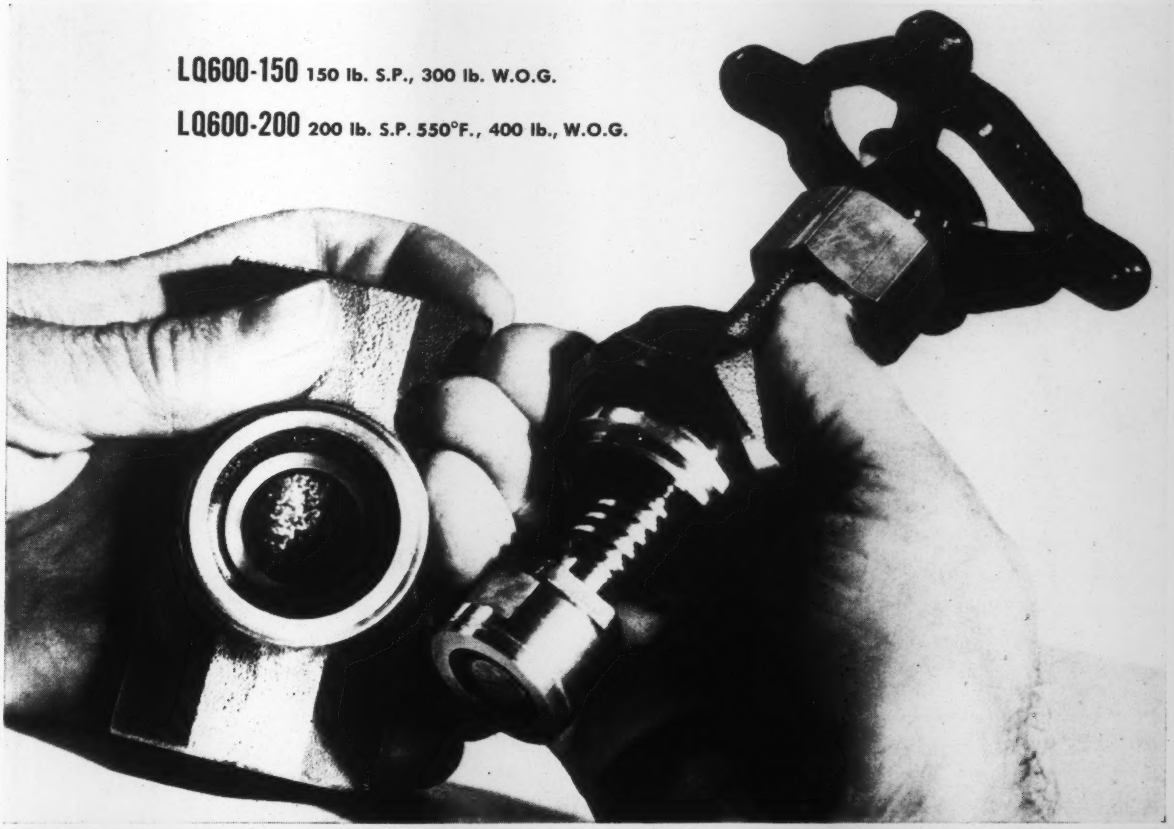
These outstanding savings are made possible by seats and discs of Brinalloy®, a patented Lunkenheimer alloy that is more resistant to wear and corrosion than 500 Brinell Stainless or 1000 Brinell Case-Hardened Stainless Steel.

Add to this the Lunkenheimer exclusive silicon-bronze Stemalloy®, the most durable stem material ever put into a valve, and you have two important reasons why LQ600's have established new low-maintenance standards everywhere they are installed.

For an actual comparison test, call the Lunkenheimer Distributor in your area. He is an expert on valve maintenance costs and will be glad to demonstrate the maintenance-saving benefits you receive when you install LQ600's . . . or write The Lunkenheimer Company, Cincinnati 14, Ohio

LQ600-150 150 lb. S.P., 300 lb. W.O.G.

LQ600-200 200 lb. S.P. 550°F., 400 lb., W.O.G.



LUNKENHEIMER QUALITY

LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

3 new applications get longer life and minimum maintenance using Dodge pillow blocks with Timken® bearings

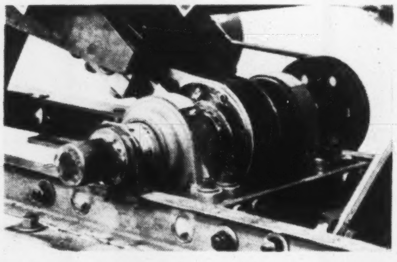
PICTURED below are three applications where Timken bearing equipped Dodge pillow blocks stay on the job with little attention under tough conditions. Their tapered design lets Timken® bearings take *both* radial and thrust loads in any combination. And full-line contact between rollers and races provides extra load-carrying capacity. Wear is reduced, maintenance is cut to the minimum.

Cutaway view shows the Dodge All-Steel pillow block with Timken bearing mounting. Of special design, the bearing has a tapered bore with self-aligning spherical outer surface—never needs adjustment.

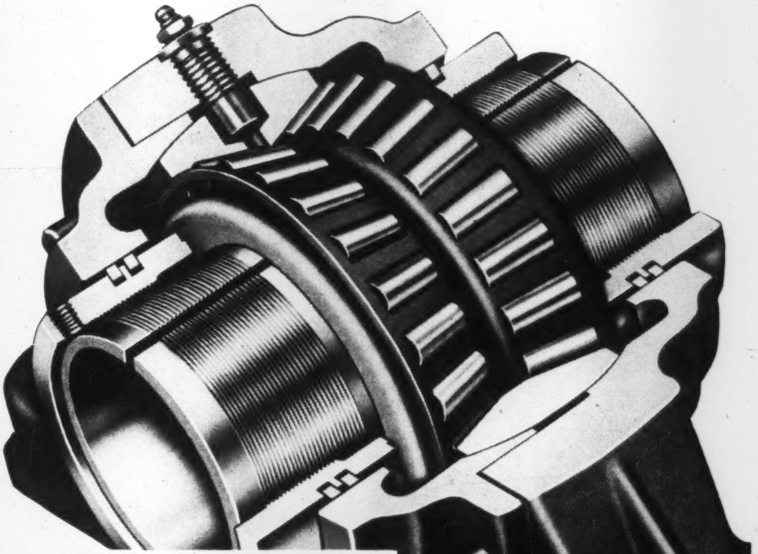
Besides the All-Steel pillow block, other versatile Dodge pillow blocks with Timken tapered roller bearings are: Type "E", Double-Interlock, Type "C" and Special Duty. All are compact in design. Special thrust devices that take up extra space are not needed.

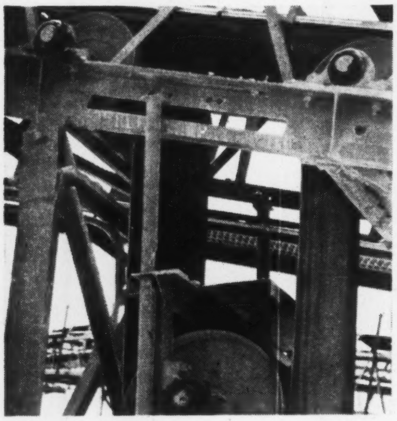
And to get the finest steel for Timken bearings, we make it ourselves—America's only bearing manufacturer that does. So specify bearings trademarked "TIMKEN" for the machines you buy or build. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

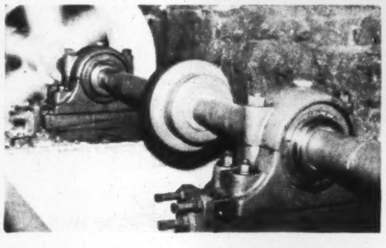


Timken bearing-equipped Dodge All-Steel pillow block used in a vibrating conveyor.





Timken bearing-equipped Dodge Type "E" pillow block used in sand and gravel plant.



Timken bearing-equipped Dodge "Special Duty" pillow block as used on fine paper machine lineshafts.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS ROLL THE LOAD